JAN 1998
97614

Presidio of San Francisco

Natural Resource Inventory and Vegetation Management Options

Prepared for:

Golden Gate National Recreation Area
National Park Service

Prepared by:

Jones & Stokes Associates
Sacramento, CA

November 1997

Photograph by Charles Kennard

97614

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Natural Resource Inventory and Vegetation Management Options

Prepared for:

Golden Gate National Recreation Area
National Park Service
Fort Mason, Building 201
San Francisco, CA 94123
Contact: Nicholas Weeks
415/561-4834

Under contract to:

Jones & Jones
105 South Main Street
Seattle, WA 98104

Prepared by:

Jones & Stokes Associates, Inc.
2600 V Street, Suite 100
Sacramento, CA 95818-1914
Contact: Ken Casaday
916/737-3000

November 1997

This document should be cited as:

Jones & Stokes Associates, Inc. 1997. Presidio of San Francisco natural resource inventory and vegetation management options. November. (JSA 93-168.) Sacramento, CA. Prepared for Golden Gate National Recreation Area, National Park Service, San Francisco, CA.

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Chapter 1. Introduction

PURPOSE OF REPORT

The purpose of this report is to document the condition of natural resources at the National Park Service's (NPS's) Presidio of San Francisco and to identify options for future management of these resources. Thus, this document can provide a basis for establishing a natural resource and forest management plan for the Presidio.

The Presidio forest is the focus of this assessment. This introduced forest, located at the windswept tip of the San Francisco Peninsula (Figures 1-1 and 1-2), is now in an advanced stage of maturity and requires vigorous restoration. A plan for the long-term care and evolution of the forest is needed that will protect and restore its historic and natural habitat values and provide a safe and suitable environment for the Presidio's activities. Following a thorough inventory of historical and current resource conditions, management options are formulated in this document that could:

- restore the Presidio's historic forests according to the original design intent;
- protect, enhance, and enlarge native vegetation and wildlife communities; and
- protect Presidio staff and visitors from hazards presented by the interaction of wind, other natural events, and mature forest trees.

Actions to implement such a management plan should be taken incrementally as demands or opportunities arise, such as following loss or damage of a particular forest stand from high winds or the outbreak of plant disease. Actions should embody a concept of adaptive management, resulting in amendment to the established plan and implementation techniques from time to time as experience dictates.

A future resource management plan, based on this inventory and identification of management options, must be fully compatible with the Golden Gate National Recreation Area's (NRA's) 1994 General Management Plan Amendment (GMPA) for overall management of the Presidio (Golden Gate National Recreation Area 1994a). The decision notice for the GMPA, based on a final environmental impact statement (EIS) prepared for the GMPA adoption (Golden Gate National Recreation Area 1994b), determined that the historic planted forest should be revitalized and restored to its originally designed boundaries, historic vistas should be cleared, and native

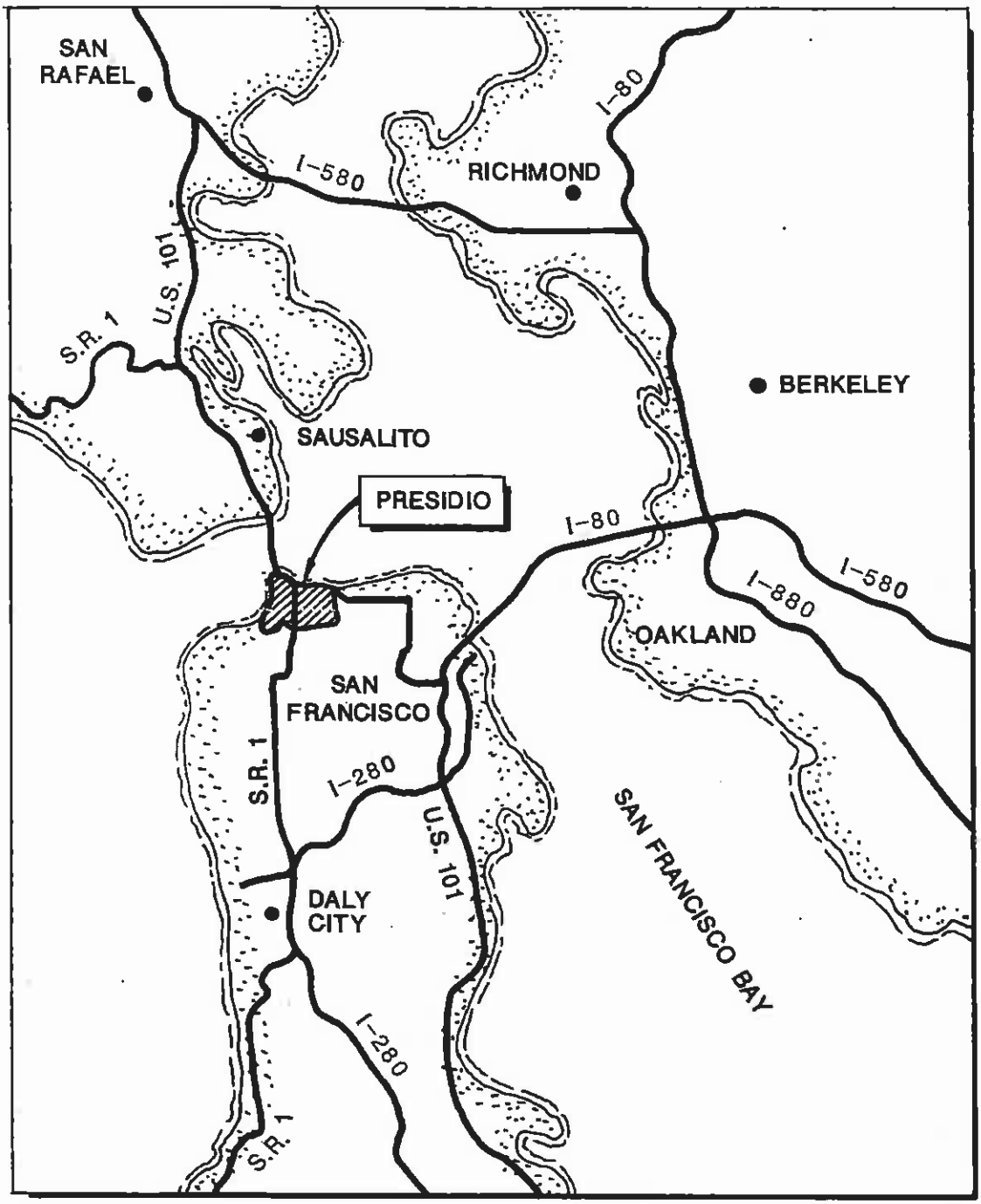


FIGURE 1-1. LOCATION MAP

habitat should be restored outside the historic forest boundaries. Identification of methods for implementing these policies was deferred to a future forest management plan.

Resource inventory data and management options presented in this document pertain principally to lands managed by NPS. They also apply to certain lands within the Presidio managed by other agencies, including the San Francisco National Cemetery managed by the U.S. Department of Veterans Affairs, and transportation corridors such at the Golden Gate Bridge approaches, which are managed by the California Department of Transportation (Caltrans) and the Golden Gate Bridge District.

DOCUMENT ORGANIZATION

The plan is divided into two major parts: a natural resource inventory and a discussion of management options.

Chapters 2 and 3 provide the resource inventory. Chapter 2 describes the history of native vegetation and the introduced forest at the Presidio. Chapter 3 is a detailed inventory of the present forest, native vegetation, wildlife, soil erosion, and other factors. It is based on inventories of the forest conditions and hazards and on surveys of vegetation and wildlife conducted previously for the U.S. Department of the Army and, more recently, for NPS.

Management options are described in Chapters 4-8. Chapter 4 describes the park's resource values, management issues, and recommended management goals. Chapter 5 presents recommended resource management options throughout the park. Recommended treatments and options for implementation of any natural resource management plan are detailed in Chapter 6. Chapter 7 discusses the recovery and use of wood resources that should occur during and after management actions.

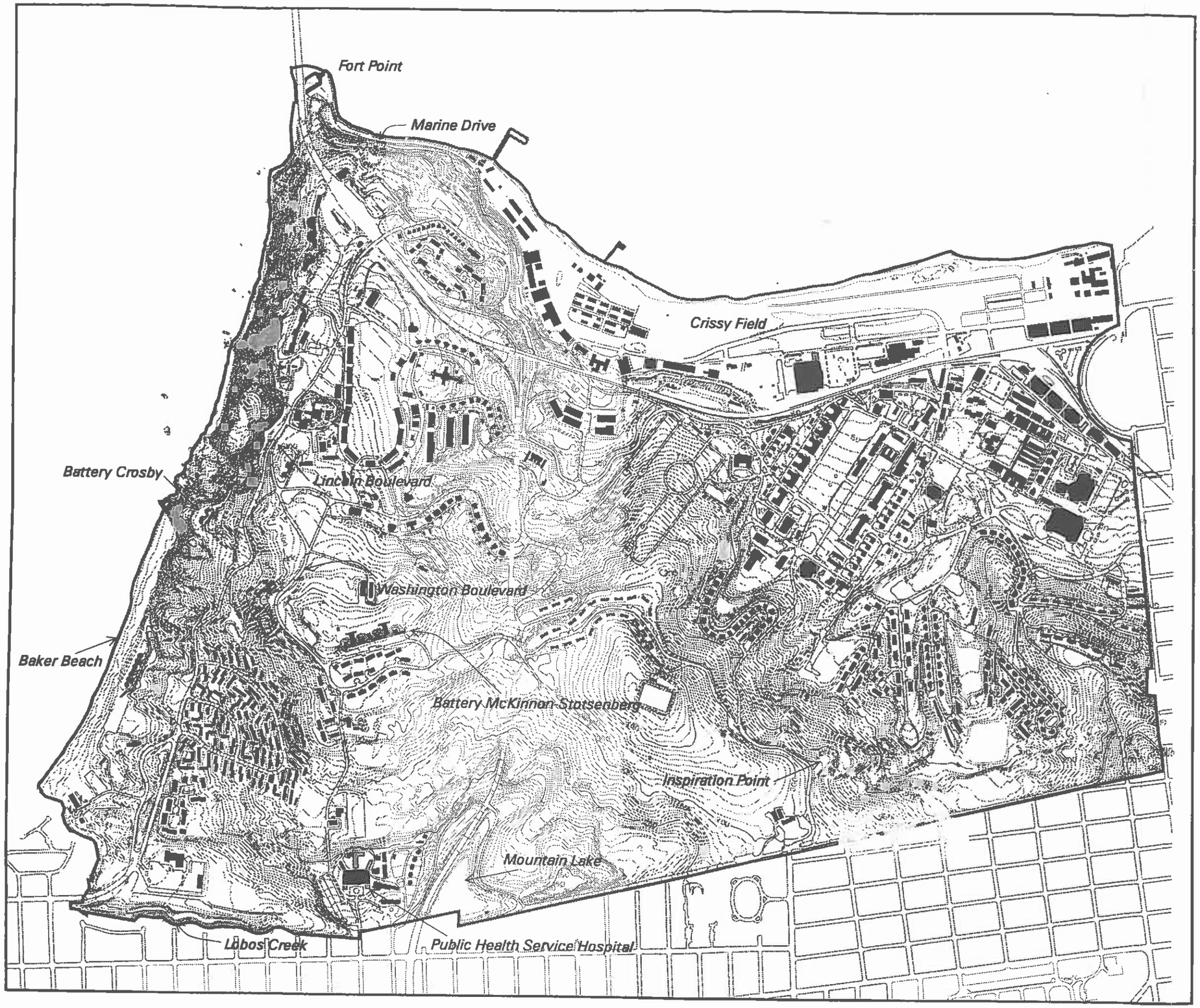


FIGURE 1-2. THE PRESIDIO OF SAN FRANCISCO

Source: Golden Gate National Recreation Area computer map files

Chapter 2. Natural Resource History

PREHISTORIC VEGETATION

Introduction

Trees were not a conspicuous feature in the landscape around what is now San Francisco before the settlement of the area by Europeans, but the earliest reports by explorers indicate that small trees of several kinds were found on the hills and summits. These explorers wrote of the scrubby oaks and "dwarf horse chestnuts" (probably California buckeye) scattered on slopes above their anchorages (Howell et al. 1958). (Scientific names of plant species referred to in this plan are listed in Appendix J, "Common and Scientific Names of Plants Mentioned in the Presidio Natural Resource Inventory".) The only native trees presently growing on the Presidio are coast live oak and arroyo willow, and the largest stands of these species are primarily limited to the riparian forests near Lobos Creek and Mountain Lake. Scattered small patches also occur on the Presidio.

Site Conditions

The Presidio's climate was, and still is, characterized by moderate temperatures with few frosts, frequent screening of morning and afternoon summer insolation by fog, summer fog drip, winter rain, and strong marine winds. The general distribution of the Presidio's native vegetation was determined by wind patterns and solar aspect. Local effects on vegetation distribution were the result of the mosaic of soil-geologic units present, local exposure to windborne salts, soil moisture, and incidence of fire.

Fairly continuous and often high winds significantly affected the distribution of the Presidio's vegetation, especially along the immediate coastline. The windswept slopes facing southwest toward the ocean were dominated by grasses and prostrate shrubs, and trees were found only in the sheltered valleys and leeward hillslopes. Coast live oaks withstood high winds by assuming a prostrate form.

Site conditions at the Presidio are described more fully in Chapter 3, "Natural Resource Inventory".

Native Vegetation Distribution

Wind, aspect, fire, soil moisture, and soil type combined to create a mosaic of native plant communities at the Presidio before European settlement. Coastal prairies, coastal scrublands, oak woodlands, riparian forests, and wetlands formed distinct botanical communities with associated wildlife values.

Historic Observations

The earliest European observers reported that eastward of an extensive treeless area along the coast lay hills and valleys covered with a mosaic of marsh vegetation, grass, low live oaks, occasional other trees, chaparral, and a sparse scrubby growth (Clarke 1959). They also noted "tufts of trees" on the ridges near Mission Dolores but did not identify them. Dr. H. H. Behr, one of the first observers to inventory the San Francisco flora, described a fringe of California laurel along the city's northern shoreline and an unknown conifer growing on Lone Mountain (Howell et al. 1958). Thus, the area now constituting the Presidio was probably not completely lacking in tree cover, as reported by the first Americans in their journals, sketches, and photographs.

The Anza expedition in 1776 described the area near Mountain Lake and the high tableland, including Fort Scott and extending northward to Fort Point, as treeless and covered with a growth of grass, yerba buena, lilies, and wild violets. The soil of this area is partly dune sand and partly derived from serpentine, both of which are likely to be treeless.

During the Spanish period, the largest oaks and thickest chaparral of San Francisco probably grew on eastern hills of the Presidio, whereas the dune-sand areas to the west, north, and south were largely covered with grass and other herbs. According to Behr, "the scrub of *Quercus agrifolia* (coast live oak) now to be seen in the [Golden Gate] park fairly represents the original oak vegetation" (Howell et al. 1958). The live oaks were not evenly distributed on the hills but formed groves or clusters, mostly on north-facing slopes and in the arroyos. Other trees, such as buckeye, madrone, and California bay, may have occurred with coast live oak in live oak woodlands (Clarke 1959).

From the Spanish accounts, the exact distribution of these various types of vegetation is difficult to determine. The later American accounts give specific locations and even provide lists of species for some of the vegetation types but the vegetation cannot be assumed to have remained unchanged throughout the Spanish and Mexican periods. Accordingly, Clarke (1959) used the diaries of the early explorers to determine the distributions of vegetation communities in the San Francisco Bay Area; excerpts from some of these diaries are presented in Appendix C, "Some Observations of the Early Explorers".

Inferences from Soils and Geologic Units

Figure 2-1, prepared for this report, displays natural vegetation for the Presidio inferred from geologic units and soils. It is based on the soil-geology-vegetation associations shown in Chapter 3, "Natural Resource Inventory" (see also Table 3-1 and Figure 3-1b).

Basis for Soil-Vegetation Association Inferences. The delineated association of landscape components reflects the correspondences of vegetation community to soil type, of soil type to parent material, and of parent material to geologic formation. This correspondence is mutual and interactive; for example, the soil type is in part determined by the type of vegetation growing on it.

The relationship is not restricted to a one-to-one correspondence, however; more than one soil type may develop on a given parent material, and more than one vegetation community may occur on a given soil type. For example, coastal prairie and coastal scrub are not always separable as biological communities. Some soils clearly favored development of one or the other of these habitats, and at these sites the distinction is clear. Other soils, however, could support either habitat depending on additional environmental factors such as fire or grazing. More frequent fire favored grassland over scrub. On some soils, in the absence of fire, grassland may be a successional stage to coastal scrub. After European settlement, heavy grazing may have favored scrub over grassland.

Figure 2-1 is a map of prehistoric, not existing, conditions; this caution applies to the parent material and soil type attributions as well as the vegetation communities. The map and legend reflect the best assessment of the natural ecosystem landscape of the Presidio around the middle to late 1700s, or just before the first Spanish settlers arrived.

Use of Map. The purpose in creating this map is to establish a basis for planning natural ecosystem restoration of portions of the Presidio by identifying the appropriate natural ecosystem type for each potential restoration area.

Soil and Geologic Map Information. The first step in preparing the map was to compile all available geologic and soils information on the Presidio (depicted in Figure 3-1a). The geologic and substrate map published in the U.S. Army's forest management plan (Jones & Stokes Associates 1990a) was found to be generally accurate, requiring only minor modifications. More specific bedrock identifications were made after field investigations, and extrapolations were made from these identifications to prehistoric conditions (i.e., by determining what underlies present areas of artificial fill).

Other documents, such as geologic studies by Wahrhaftig (1984, 1993), provided much clarification. The modern soil survey of San Francisco County (U.S. Soil Conservation Service 1991) was found to be too limited in scale and accuracy for the purposes of this study. The historic soil survey was consulted (U.S. Department of Agriculture, Bureau of Chemistry and

Soils 1917) but also proved of limited value. Therefore, a new order 2 soil survey was conducted as part of the present study.

This soil survey differed from the typical survey in that its primary purpose was to map the soils that existed circa 1750. In areas of the Presidio that have undergone complete soil alteration, such as the former salt marsh and freshwater marsh along the north shore, the landscape map was reconstructed by referring to various historic Presidio maps showing these features (Land and Community Associates 1993) and inferring soils from soil types present in comparable natural areas that remain.

Vegetation Correlations. The names and descriptions of the vegetation communities used on the map are based on the ecosystem classification established by Holland (1986, 1990). Attributing vegetation communities to the geologic units, parent material, and soil map units was accomplished by comparison with existing areas of natural vegetation on the same geologic and soil types in the western San Francisco Bay region. One result of the geologic and soil literature review and field survey was the establishment of a close geologic (Wahrhaftig 1993) and edaphic connection between the Presidio and the Marin Headlands. This is reflected in the similarity of prehistoric vegetation between the two areas.

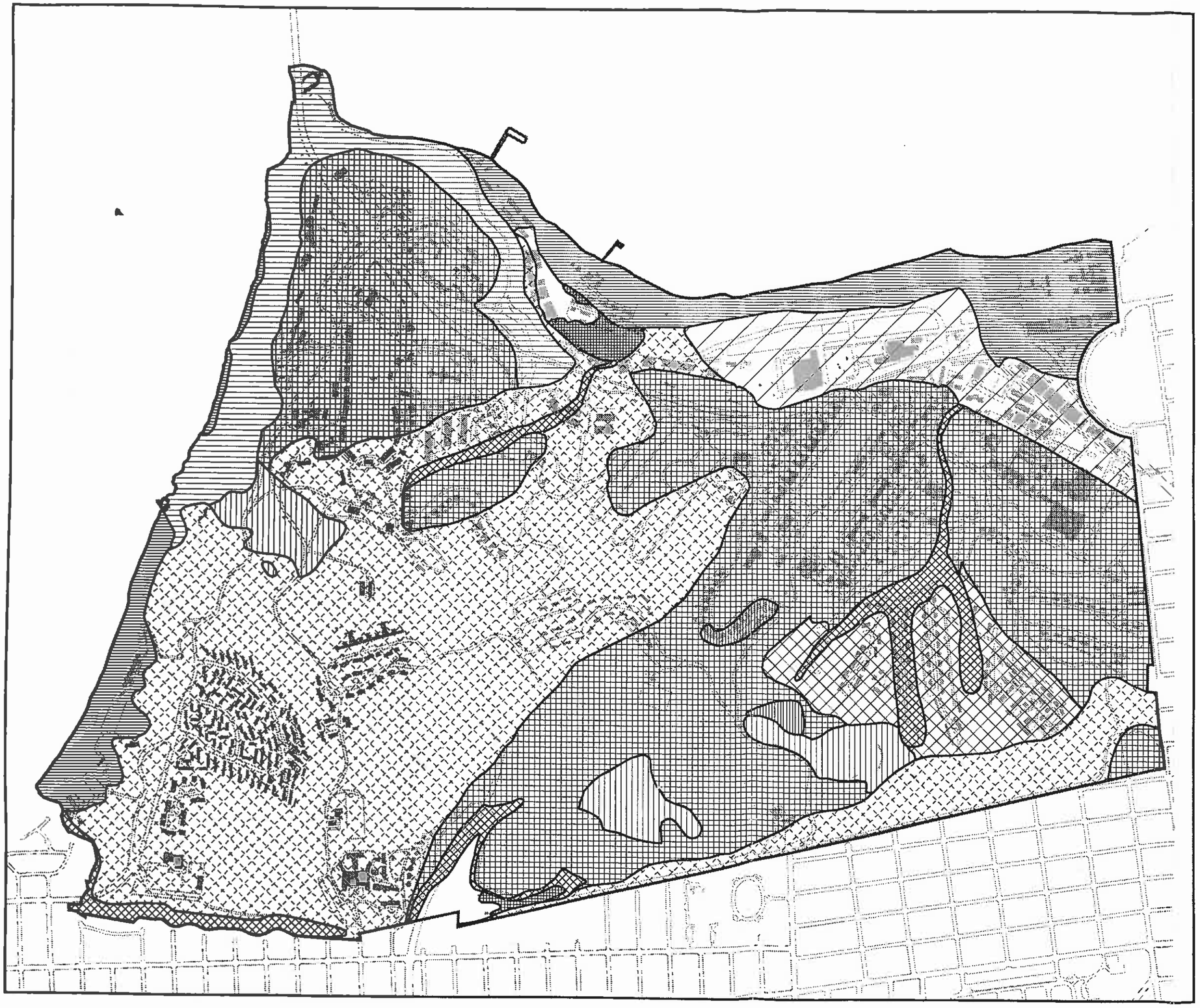
The prehistoric vegetation communities inferred by this method were compared to the historic descriptions and accounts of vegetation contained in this plan. A strong correlation was found, providing some verification of the method for determining preexisting natural vegetation communities.

Special-Interest Soils. Two points of special interest may be noted as a result of making the soil-geology-vegetation community association map. First, the Colma Formation, an assemblage of alluvial, lake, and marsh deposits along with old sand dunes dating from the glacial and interglacial phases of the Pleistocene Epoch, extends in a band from Daly City to Millbrae as well as including portions of the Presidio. All areas of the Colma Formation outside of the Presidio have now been urbanized; the only significant remaining areas of relatively natural soil on the Colma Formation exist at the Presidio of San Francisco. Second, the occurrence of serpentinite-derived soils and rock outcrops on the Presidio coastal bluffs, although not unique, is unusual, particularly for its areal extent.

Erosion Conditions

The extent of soil erosion and its significance to the presettlement ecosystems of the Presidio may be evaluated in a manner similar to the reconstruction of the type and distribution of those ecosystems. The type of soil and bedrock, combined with local climate, topography, inferred hydrology, and natural vegetation, indicate the likelihood of erosive conditions and their

FIGURE 2-1. PROBABLE PREHISTORIC NATIVE VEGETATION COMMUNITIES



PREHISTORIC VEGETATION

- Central Coast Arroyo Willow Riparian Forest and Live Oak Riparian Forest
- Central Dune Scrub
- Coast Live Oak Woodland and Northern Coastal Scrub
- Coastal Freshwater Marsh
- Coastal Terrace Prairie
- Coastal Terrace Prairie and Northern Coastal Scrub
- Northern Coastal Bluff Scrub, Northern Coastal Scrub, and Serpentine Chaparral
- Northern Coastal Salt Marsh
- Northern Foredune
- Open Water
- Serpentine Grassland and Serpentine Chaparral

Scale 1" = 1000'

0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

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impacts. This analysis is supported by a comparison of erosion potential among nearby seminatural areas and with the same soil types.

Although sand dunes are extremely susceptible to wind erosion and dune movement, the soil type that characterizes most of the dune areas on the Presidio, the Sirdrak series, shows an accumulation of organic matter, indicating that a substantial period of vegetative cover and dune stability had occurred before European settlement. With a relatively sparse, yet homogeneous, vegetative cover; a high rainfall infiltration capacity; and dispersal of limited runoff, the dune-sand soils were generally not subject to water erosion.

Soils derived from Colma Formation alluvium and Franciscan Formation bedrock are subject to water erosion, particularly on steeper slopes. The extensive native grassland and scrub and limited woodland vegetative cover was sufficient to substantially reduce the potential erosion hazard. Vegetation loss caused by infrequent major disturbance, such as a rare intense fire, would have initiated a cycle of severe erosion until vegetation returned. The degree of soil aggregation, even under bare soil conditions, would have limited the wind erosion potential.

In general, severe soil erosion would not have been a component of the presettlement natural ecosystem of the Presidio. The notable exception is the sea cliffs and bluffs along the northwest shoreline. The steep slopes, undercut by wave action, were prone to landslides and gully formation. This is especially true of the serpentine cliffs exposed on the bluffs. The landscape instability of the coastal bluffs may still readily be seen.

VEGETATION CHANGES IN THE SPANISH PERIOD

By 1820, the following trees and large shrubs in the Presidio area had been described by explorers:

- Pacific madrone *(Arbutus menziesii)*,
- toyon *(Heteromeles arbutifolia)*,
- Pacific wax myrtle *(Myrica californica)*,
- hollyleaf cherry *(Prunus ilicifolia)*,
- California bay laurel *(Umbellularia californica)*,
- coast live oak *(Quercus agrifolia)*, - NATIVE, current
- California buckeye *(Aesculus californica)*,
- yellow willow *(Salix lasiandra)*, and
- arroyo willow *(Salix lasiolepis)*. - NATIVE, current

These species are all native to the central California coast, but whether all of these species were present at the presidio before European settlement is unknown; some of them may have been introduced by the Spanish explorers from nearby areas.

During the early years of Spanish occupation, activities of the inhabitants affected only certain areas. Agriculture was limited to the immediate vicinity of Mission Dolores, and the Spanish inhabitants generally did not travel far beyond the established routes between settlements. Until 1835, when Yerba Buena was first occupied, the main settlements in San Francisco were the mission and the Presidio. In their vicinity, trees and brush were cut for firewood and live oaks were used to construct buildings, palisades, and furniture.

Eventually, many of the oaks, shrubs, and grasses in the area that had furnished acorns, berries, and grains to the local Native Americans disappeared to meet the demands for timber, firewood, and forage. Herds of sheep, goats, cattle, horses, and mules were allowed to graze unhindered and uncontrolled, reducing many grasslands to rocky, barren sand patches or dunes.

The most widespread changes in vegetation during the Spanish period were a decrease in grass and a probable increase in brush as a result of heavy grazing by livestock. Although chaparral is mentioned in the early Spanish reports, abundant and good pastureland is noted more frequently. The extensive chaparral mentioned in later accounts was probably less widespread when the Spanish first arrived, but accounts from the 1840s suggest that decimated pastures and a colonizing growth of chaparral were already present by that time.

VEGETATION DURING THE AMERICAN PERIOD

By the time the U.S. Army occupied the Presidio, trees were few and confined primarily to the moister hollows and drainages far from developments and sheltered from the wind. These were apparently groves of shrubby coast live oak. The Army officers and troops, most of whom were from the woodlands of the eastern United States, found the Presidio, in general, to be barren, bleak, and windswept.

Afforestation

Original Landscape Plan

In 1882-1883, Army Major W. A. Jones, under the direction of the Commander of the Department of the Pacific, developed a "Plan for the Cultivation of Trees upon the Presidio Reservation" (included in this report as Appendix E). This effort stands as a first and relatively rare example of landscape planning on such a large scale for an army reservation. The information and quotations below are taken from this plan (Jones 1883).

The plan proposed a major tree planting program patterned after the successful efforts of the City of San Francisco's Golden Gate Park, begun in 1870. In the original plan, Major Jones

articulated the primary purpose of establishing a forest at the Presidio: to create a system of windbreaks. He added what he considered to be important visual concerns: "the main idea is to crown the ridges, border the boundary fences, and cover the areas of sand and marsh waste with a forest that will generally seem continuous and thus appear immensely larger than it really is . . . ." As planned, "the eucalypti [should be] principally disposed along the crest of the ridge in order to increase, by their great height, the effect of the height of the hills."

Major Jones also noted that "by leaving the valleys uncovered . . . the contrast of height will be strengthened". Moreover, he recognized the importance of leaving some of the grassy, prominent summits, such as Inspiration Point, free of forest trees to protect the expansive views.

Accompanying the eucalyptus stands were to be stands of Monterey cypress; their role was to add a "dark mass" of greenery from the ground to where the eucalyptus towered above, giving the appearance of depth. The "bright flowering Acacia should be placed to light up the dark masses behind as seen from the Presidio [parade grounds]".

Monterey cypress was to be used extensively on the southern borders, with masses of Monterey pine and eucalyptus used at the entrances. A "thin run" of eucalyptus was to be used on the eastern borders. Near the ocean, Monterey pine and Monterey cypress were to be planted in masses, but in separate species groups.

The plan specified tree planting on each of the three main ridges that surrounded the main post. The valleys were to be left "uncovered or with a scattering fringe of trees along the streams". The main post area was intended to be kept free of masses of trees because "they would add considerably to the dampness, and render it less comfortable as a dwelling place".

"In order to make the contrast from the city seem as great as possible, and indirectly accentuate the idea of the power of the government," the major entrance roads (present-day Arguello, Presidio, and Lombard Streets) were intended to pass through dense woods and then open out into areas with beautiful vistas of the bay opposite forested ridges. Emphasis was also placed on using trees in naturalistic, irregular-shaped masses and "artistically arranged" clumps in small groups.

Thus, the barren, windswept Presidio would be transformed into a setting that was more familiar and comfortable for those who considered the tree-covered, picturesque landscape of the eastern United States to be the ideal.

Influences on Original Landscape Plan

The park development and planting efforts at the Presidio and Golden Gate Park were influenced by a nationwide trend in the mid-19th century toward the development of large, urban forest parks (Laurie 1975, Kruse pers. comm.). The first major examples were Central Park in

New York City (1858) and Prospect Park in Brooklyn, New York (1868). These large urban parks were intended to provide a refreshing contrast to the dense urban tenements developing in the large cities in the mid-19th century.

Although this was not the chief impetus for forest and park development at the Presidio, the positive experience of park developments in New York City and Buffalo, New York; Boston, Massachusetts; and Detroit, Michigan, does appear to have been the stimulus for the development of Golden Gate Park. This, in turn, provided an example to Major Jones for the Army to use in developing the windbreak forest with a parklike setting on the Presidio.

The 1883 Presidio landscape plan reflected many of the design principles employed in the Golden Gate Park landscape design. Carefully located windbreaks, plantings of tall trees surrounded by evergreens on the ridges, planted borders to screen the city, roads winding in and out of the forest with designated views, and valley bottoms kept unforested were techniques used by the developers of Golden Gate Park (Vreeland 1987).

Plan Implementation

Although the plan was accepted in 1883, only limited work took place at that time. In 1886, however, 3,000 trees were planted on California's first Arbor Day. In 1889, congressional appropriations were initiated to continue implementing the plan.

Approximately 50,000 acacia, pine, cypress, and eucalyptus trees and 5,000 redwood, spruce, and madrone trees were planted that year. For some time, at the invitation of the U.S. Army, San Franciscans joined in the Arbor Day celebrations to help forest the Presidio. By 1893, more than 350,000 trees had been planted, and by the turn of the century, plantings totaled almost 450,000 trees.

The rectangular grid on which some areas were planted is not called for in Major Jones' plan. It may have simply been used by others as a way of keeping trees sufficiently spaced when planted by unskilled troops or prison laborers, or it may have resulted from planting in horse-plowed furrows. This planting style has given the mature stands a uniquely structured, military look.

In 1907, Major W. W. Harts prepared an inventory and plan to aid further implementation of Major Jones' plan.

Erosion Control Concerns

As noted, the intent of afforestation was not merely landscape beautification, but also creation of windbreaks to reduce wind erosion and provide a more permanent vegetative cover

to reduce water erosion (Hall 1902, Harts 1907). Severe soil erosion had become a major problem in the management of the Presidio by the turn of the century as a result of 125 years of livestock grazing, vegetation removal, and foot and horse traffic during military exercises.

Descriptions of the eroded conditions on the Presidio at the turn of the century are as follows (Hall 1902): The slopes south and east of Inspiration Point were "ugly . . . with erosion"; the precipitous southwest-facing slope between the golf links and the hospital (above Mountain Lake) was eroded, with sediment washing into the lake; numerous footpaths in the sandy soil of the southwest corner of the Presidio were contributing to erosion; huge gullies were present on the steep, west-facing slopes below Stafford Battery (north of Baker Beach); soil had been removed from the Fort Scott area; and "violent" erosion was occurring on the eastern slopes. In all cases, the planting of trees was recommended as an erosion control measure. In addition, the elimination of footpaths in the sandy soil was recommended.

General erosive conditions south and east of Inspiration Point, around and above Mountain Lake, and on the eastern slopes of Fort Scott have largely been eliminated with the maturing of the existing historic forest. The efficacy of the trees and their root systems in stabilizing the soil and reducing erosion is undeniable. Yet, soil erosion problems persist in the sandy soils, largely as a result of foot traffic, and may even be exacerbated by the presence of the trees and the inducement of a hydrophobic soil condition in the sandy soil (see Chapter 3, "Natural Resource Inventory").

Delineation of the Historic Forest

Figure 2-2 is based on an Army map of the Presidio that was prepared in 1910 or shortly thereafter, which is the earliest depiction of the historic plantings based on Major Jones' 1883 landscape design. The original map that accompanied Jones' report cannot be found. The map is based on Major Harts' 1907 mapping, which may have reflected both implemented and planned afforestation. Thus, it is unclear whether all of the wooded areas shown were actually present. Ground-level photographs taken between 1890 and 1930 and the first complete set of aerial photographs of the Presidio, taken in 1935, also document the locations of many of the original plantings.

Figure 2-3 is based on the 1935 photographs and therefore records actual afforestation, excluding any of the early plantings that failed to survive environmental conditions at the Presidio. Figure 2-4 shows the historic stands in comparison to today's stands. The 1935 distribution of the forest is considered to be the best depiction of the adapted historic forest that conforms to the original design intent. Figure 2-3, representing 1935, is considered to depict the "historic forest" in terms of contributing to the National Historic Landmark status of the Presidio and is used in the remainder of this plan.

Changes after Afforestation

Except in the period following the 1906 earthquake, the U.S. Army appears to have followed Major Jones' and Major Harts' recommendations until approximately 1910. Thereafter, additional planting and natural regeneration began to occur in some of the areas intended to remain open. Meanwhile, the wide variety of tree species planted at Major Jones' instruction was reduced to those species that proved able to survive the harsh site conditions, primarily Monterey cypress, Monterey pine, and eucalyptus. A few other species, such as sycamore and redwood, survived in isolated, protected sites (Kruse pers. comm.).

After the Spanish-American War, the U.S. Army built military housing in parts of the windbreak forest. Most of the housing units did not significantly interrupt the windbreak function, and they allowed Presidio residents to benefit from the amenities of the forest: a visual screen from the city, a windbreak, and a somewhat rural environment.

The Presidio golf course was developed after the initial Presidio landscape design had been implemented. Plantings apparently occurred from the turn of the century onward. Mixed Monterey cypress and Monterey pine stands were used to delimit fairways and tees. Eucalyptus formed the golf course perimeter, and one large grove of eucalyptus was planted in the center of the course.

The Presidio boundary plantings have been kept mostly intact. The forest was planted before adjacent private residential development began, but in places it has matured to block bay views of adjoining residences.

Recent U.S. Army Management Policies

In recent decades, management of the Presidio forest by the U.S. Army has primarily involved maintaining the introduced forest. Down material has been removed from certain areas, and groundcover has been mowed. Hazardous fuel accumulations have been removed and all fire suppressed. Trees in certain stands have been pruned or removed to avoid or eliminate imminent hazards. Some of the more remote stands, however, were allowed to grow wild and have been left relatively unmaintained. No efforts to regenerate the historic forest were undertaken.

Many of the trees along the southern boundary have been topped by neighbors from time to time. Although the U.S. Army was under no legal obligation to maintain private view corridors, it allowed some neighbors to top obstructing trees. This practice was stopped in December 1990. The trees have responded to the toppings by forming a low, continuous, matted canopy.

FIGURE 2-2. APPROXIMATE EXTENT OF THE INTRODUCED AND NATIVE FOREST CIRCA 1910

Source: Office of the Contracting Quartermaster, San Francisco, U. S. Army

Scale 1" = 1000'

0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

15-Nov-95

FIGURE 2-3. APPROXIMATE EXTENT OF THE INTRODUCED AND NATIVE FOREST 1935

Source: Scanned 1935 aerial photographs

Scale 1" = 1000'

0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

15-Nov-95

FIGURE 2-4. HISTORIC FOREST COMPARED TO PRESENT FOREST



LEGEND

- Historic forest 1935
- Present forest 1994

Sources: McBride 1988, revised by Jones & Stokes Associates and scanned 1935 aerial photographs.

Scale 1" = 1000'

0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

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In 1993 and 1994, as a part of base closure and transfer to NPS, the U.S. Army carried out some hazard tree treatment in the more developed, landscaped portions of the Presidio, but the pruning methods used will result in only short-term benefits (see Appendix B, "Tree Hazard Assessment and Hazard Tree Management Plan", for a more detailed discussion).

THE PRESENT FOREST

Nearly all of the original forest stands at the Presidio have matured into the magnificent forest Major Jones envisioned more than 100 years ago. The limited development that has occurred in the originally forested areas has been designed and constructed with obvious sensitivity. The meandering streets and structures built on the contour are in marked contrast to the erect grid imposed upon the topography by the surrounding city. Today, the "contrast from the city" that Major Jones sought to maximize is quite apparent and successful.

The forest has aged, however, and many trees have exceeded their normal life span. Within larger historic stands, natural or artificial regeneration is occurring only in limited areas. In the absence of intensified treatment, tree losses in the historic stands will increase. Although eucalyptus and a few other stands may continue to expand, the overall extent of the forest will substantially diminish in the next two decades. Chapter 3, "Natural Resource Inventory", describes the current condition and trend of the Presidio's forest and landscaping trees.

Chapter 3. Natural Resource Inventory

INTRODUCTION

The Presidio's open space lands are largely occupied by planted forest stands. Other open spaces include areas of native vegetation, landscaping trees, shrubs, and lawns, as well as paved areas, cleared areas, and disturbed areas occupied by weedy vegetation. This chapter focuses on the Presidio's forests and remaining native vegetation communities. In separate sections, this chapter describes the Presidio's forest in terms of:

- environmental conditions;
- native and non-native, nonforest vegetation;
- adaptation of the introduced forest;
- present forest character;
- present forest condition and hazards;
- wildlife habitats;
- recreational resources;
- visual resources; and
- soil erosion.

ENVIRONMENTAL CONDITIONS

Temperature, solar exposure, precipitation, wind, and soil type affect the amount and distribution of vegetation at the Presidio. The Presidio is one of the harshest environments on the San Francisco Peninsula for tree survival. Its limited native woodlands were located near the creek and draw bottoms and in deeper, moisture-holding soils on the northern and northeastern sides of the hills, sheltered from the strong, saline marine winds.

Temperature

Mild annual temperatures; virtually frost-free winters; and cool, foggy summers are primary climatic determinants of vegetation distribution and growth at the Presidio. These factors render unsuitable any tree species that require either a frost to induce seasonal dormancy or a hot, dry climate to control disease infestations. The moderating oceanic influence on summer temperature

and humidity in the Presidio forest is important because summer drought is the key factor governing plant distribution and growth in California.

Solar Exposure

As is usually the case at this latitude, the difference between the amount of sunlight received by north-facing and south-facing slopes at the Presidio is great. These aspects accordingly differ considerably in soil temperature, soil moisture, and air temperature near the ground. Although west-facing, afternoon-heated slopes are usually warmer than east-facing, morning-heated slopes, the effect at the Presidio is ameliorated by the fact that summer fogs are common in both the morning and afternoon, alternately shielding east- and west-facing slopes and preventing high heat gain in the afternoon.

As elsewhere in coastal California, the variations in soil moisture and temperatures of the soil and air are reflected in the distribution of vegetation. Slopes that face south and southwest tend toward chaparral and grassland; slopes that face north and northeast tend toward woodlands.

Precipitation

Annual rainfall on the Presidio ranges from 12 to 24 inches. Most of this rainfall occurs during winter (from December through March). This pattern and amount are similar to those of the Mediterranean climatic regions of the world. In addition, the persistent fog provides significant (although unmeasured) summer moisture and limits evapotranspiration losses.

Wind

Wind constantly affects plant growth at the Presidio, and wind pruning is widespread. Ocean winds are strongest during spring, when vulnerable new growth is emerging. The Presidio's native tree species (e.g., coast live oak) have natural wind protection mechanisms such as low growth form, but most trees cannot protect themselves from the constant desiccation and salt damage caused by continually windy conditions and do not live long in areas exposed to the ocean wind. Four of the five primary tree species introduced at the Presidio, however, are well adapted to coastal environments.

Regional topography is responsible for high winds at the Presidio. The gap in the Coast Ranges at the San Francisco Bay allows large volumes of air to move in the direction of the prevailing wind into California's Central Valley. The dominant onshore winds throughout the year originate in the southwest and west, accounting for about two-thirds of all winds. This pattern includes both cyclonic storm disturbances in winter and prevailing, gentler summer winds.

Severe wind episodes have occasionally caused limb and stem breakage or toppling of individual or groups of trees. Losses have increased over time as the introduced forest has matured. Based on similar experience at Golden Gate Park, which was afforested a few decades before planting began at the Presidio, wind damage and loss of forest stands can be expected to continue to increase in the future.

Soil Conditions

Geologic units of the Presidio are shown in Figure 3-1a, and integrated soil-geologic-vegetation units are shown in Figure 3-1b. Table 3-1 explains the four-digit numerical code used in Figure 3-1b to represent the combination of geologic formation, parent material, soil type, and natural vegetation community represented by a particular map unit. The soils of the Presidio have undergone several significant changes since presettlement times because of physical disturbance and the growth of forest.

Soil Disturbance after European Settlement

Large areas of soil have been excavated from several quarries and cut slopes, with accompanying placement of fill, that were developed for construction of housing, roads, military fortifications, and bridges. Some of these areas, along with trails, parking lots, parks, and athletic fields, have substantial amounts of fill, primarily obtained from onsite excavation of rocky Franciscan Formation soil and parent material. This material now covers original natural soil. The former freshwater and saltmarsh wetlands of the north bayshore were completely filled for the Panama Pacific International Exposition. The land was subsequently used as parade grounds and an airstrip of Crissy Field along the north Presidio shoreline.

Much native soil has been moved or lost as a result of erosion, both in historic settlement times (as detailed in Chapter 2, "Natural Resource History") and at present (as discussed below). In addition, soils in areas of heavy use have undergone compaction.

Soil Changes Caused by Afforestation

Some soil changes are associated with the growth of the historic forest. The most apparent change is the formation of thick surface-litter layers of decomposing and undecomposed organic matter dropped from the trees. The increased organic matter may have increased soil fertility and water-holding capacity, at least in the surface horizon. Another effect of the tree-soil interaction, however, has been a substantial reduction of the soil pH level.

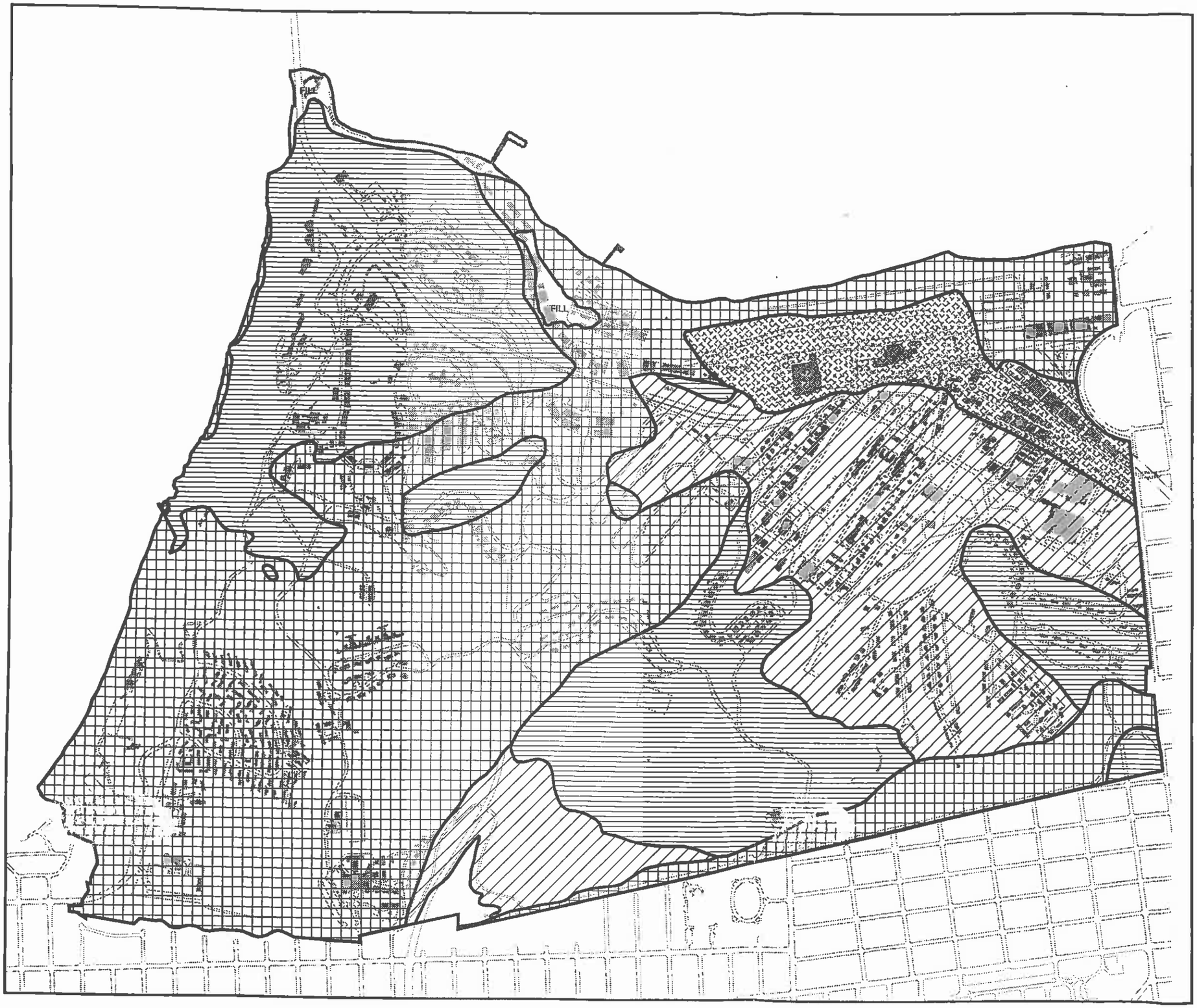
Typically, the soil pH beneath native vegetation is in the medium to slightly acidic range for the Sirdrak and Barnabe series, and slightly acidic to neutral for the Cronkhite series (U.S. Soil Conservation Service 1985, 1991). Several pH tests were performed on soils of the introduced forest of the Presidio in preparing for this plan, and the range was typically strongly acidic to extremely

Table 3-1. Associations of Geology, Soils, and Natural Vegetation for the Presidio of San Francisco

Geologic Formation	Parent Material	Soil Type	Vegetation Communities
1. Intertidal deposits	1. Tidal marsh sediment	1. Novato	1. Northern coastal salt marsh
2. Dune sand	1. Beach sand	1. Xeropsamment	1. Northern foredune
	2. Dune sand	1. Sirdrak	1. Central dune scrub
		2. Sirdrak variant	1. Central coast arroyo willow forest
			2. Central coast live oak riparian forest
	3. Marsh sediment	1. Humaquept	1. Coastal freshwater marsh
3. Colma	1. Old dune sand/alluvium	1. Pachic Haplustoll/Typic Ustropept	1. Coastal terrace prairie/ northern coastal scrub
			2. Central coast arroyo willow/ live oak riparian forest
			3. Coast live oak woodland/ northern coastal scrub
			4. Central coast arroyo willow forest
	2. Marsh sediment	1. Humaquept	1. Coastal freshwater marsh
4. Franciscan	1. Soft sandstone/shale	1. Cronkhite	1. Coastal terrace prairie/ northern coastal scrub
	2. Hard sandstone	1. Barnabe/Kron	1. Coastal terrace prairie
	3. Serpentinite	1. Henneke (variant)/Pachic Argiustoll	1. Serpentine bunchgrass/ serpentine chaparral
	4. Serpentinite (with inclusions) seacliffs	1. Henneke (variant)/Ustorthent	1. Northern coastal bluff scrub/ northern coastal scrub/ serpentine chaparral
	5. Siliceous, carbonaceous shale	1. Pablo/Bayview/(variants)	1. Coastal terrace prairie/ northern coastal scrub
	6. Soft sandstone/shale/chert	1. Cronkhite/Barnabe variant	1. Coastal terrace prairie/ northern coastal scrub
5. Open water and fill material			

Note: This table serves as the legend for Figure 3-1b, which shows four-digit codes corresponding to successive subdivisions of the geologic formations as shown above.

FIGURE 3-1a. GEOLOGIC UNITS



FORMATIONS

- Intertidal Deposits
- Dune Sand
- Colma Formation
- Franciscan Formation
- Open Water or Fill

Scale 1" = 1000'

0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

15 Nov 94

FIGURE 3-1b. SOIL-GEOLOGIC-VEGETATION UNITS



Legend: see Table 3-1

Scale 1" = 1000'

0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

osoils-f.eml

acidic under pine and cypress, regardless of the soil type tested. The pH for soil under eucalyptus was slightly less acidic, on average. The trees appear to have caused an increase in acidity of one to two orders of magnitude. The increase in acidity changes the availability of some nutrients and the composition of soil microbiota, but its principal effect, in combination with other factors, may be seen on the sandy Sirdrak soil.

Soil Hydrophobicity

Where the Sirdrak series soil of the Presidio is vegetated with pine, cypress, and eucalyptus, it has developed hydrophobic or water-repellant properties in the surface horizon (although the soils will rewet slowly over an extended period of precipitation). The effect is most pronounced when the seasonally dry soil receives the first fall rains. Water infiltration is severely reduced in the sandy soil, which would otherwise have a high infiltration rate, even in soil with well-developed groundcover. Runoff may initially approach 100% of rainfall, especially in a heavy early-season downpour such as occurred in fall 1993. Substantial runoff occurred in the introduced forest areas on Sirdrak sand as a result of that storm, and much erosion was evident following the storm.

Aside from the Sirdrak series, soils in the introduced forest have apparently not developed hydrophobic properties.

Although the physical and chemical causes of hydrophobicity are not completely understood, seven factors associated with hydrophobicity have been identified (Wallis and Horne 1992): presence of sandy soils, accumulation of organic matter, presence of mycorrhizae, acidic pH, alternating wet and dry seasons, vegetation with conifers and eucalyptus, and the occurrence of fire. The Sirdrak soil of the Presidio has all of these factors except fire. Planting the Sirdrak soil with conifers and eucalyptus, and the resulting soil changes in organic matter, mycorrhizae, and pH, has added four of the seven factors that generate hydrophobicity.

Much of the soil erosion presently observed on the Presidio and described below is most severe on the Sirdrak soil, and the hydrophobicity of the soil may be a major factor causing the soil erosion. This erosion problem requires that runoff at the Presidio be managed carefully, in particular by reducing the removal of groundcover and soil compaction caused by increasing recreational use.

NATIVE AND NON-NATIVE, NONFOREST VEGETATION

Introduction

The native plant communities that remain at the Presidio occur on the west- and north-facing coastal bluffs, extending from the maintenance shops of Crissy Field to Baker Beach, and as scattered habitat fragments in the southwestern and southeastern portions of the park (Figure 3-2). The planted and enlarged, naturalized forests have displaced most of the native vegetation of the

Presidio, and the remaining patches of native vegetation have been invaded by non-native species.

The following list identifies native vegetation communities found at the Presidio. Each community is identified using the classification system used by Holland (1986, 1990); the numbers in parentheses are classification code numbers from Holland (1990). Codes marked with an asterisk (*) indicate "communities with highest inventory priority": communities that are of limited extent, rapidly declining, or both. Following the hyphen is the name that will be used in this report to refer to each community:

- northern foredunes (21210*) - foredune,
- central dune scrub (21320*) - dune scrub,
- northern coastal bluff scrub (31100*) - bluff scrub,
- northern coastal scrub (32100) - coastal scrub,
- mixed serpentine chaparral (37610*) - serpentine chaparral,
- coastal terrace prairie (41100*) - coastal prairie,
- serpentine bunchgrass (42130*) - serpentine prairie,
- coastal and valley freshwater marsh (52410*) - freshwater marsh,
- freshwater seep (45400*) - freshwater seep,
- central coast live oak riparian forest (61220*) - live oak riparian forest,
- central coast arroyo willow riparian forest (61320*) - arroyo willow riparian forest,
- central coast riparian scrub (63200*) - riparian scrub, and
- coast live oak woodland (71160) - live oak woodland.

In addition to the non-native forest communities at the Presidio, the following treeless, non-native communities occur:

- non-native grassland (42200) and
- ice plant mats (not classified in Holland 1990).

Holland's (1986, 1990) generalized native vegetation community category "wildflower field (42300)" could be considered a habitat that occurs at the Presidio. Sites where this designation could apply, however, are more appropriately treated as successional stages or subtypes of dune scrub, non-native grassland, coastal prairie, or serpentine prairie.

Special-status plant species within the native plant communities at the Presidio are mostly concentrated in dune scrub, serpentine chaparral, and serpentine grassland habitats. These species are discussed under "Special-Status Plant Occurrence" below.

Native Plant Communities

The following sections describe the native plant communities at the Presidio that are delineated in Figure 3-2. The mapping symbol appears with the community name. Common and scientific names of plants mentioned in the text are provided in Appendix J.

FIGURE 3-2. NATIVE AND NON-NATIVE NONFOREST VEGETATION COMMUNITIES



COMMUNITIES

- F Foredunes
- DS Dune Scrub
- BS Bluff Scrub
- CS Coastal Scrub
- CP Coastal Prairie
- SP Serpentine Prairie
- SC Serpentine Chaparral
- IP Ice Plant Mats and Non-Native Grasses on Dunes
- NG Non-Native Grassland
- FM Freshwater Marsh
- OR Live Oak Riparian Forest
- WR Arroyo Willow Riparian Forest
- RS Riparian Scrub
- OW Live Oak Woodland

Sources: Mike Vasey, San Francisico State University and Jones & Stokes Associates.

Scale 1" = 1000'

0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

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pnatveg-f.eml

Foredune (F)

Foredune is an open community of the immediate coast. At the Presidio, foredune occurs immediately inland of Baker Beach and at Crissy Field. Low perennial herbs and subshrubs dominate the vegetation of the foredunes. Dominant native species in this habitat are beach sagewort, sand verbena, silver beachweed, coast buckwheat, chamisso lupine, and Douglas' bluegrass. Typically, no single species dominates the cover in this community. Non-native ice plant, however, has become a dominant species at many sites. At sites where ice plant, ripgut brome, or soft chess has overwhelmed the native species, the community is categorized as "ice plant mats and non-native grasses on dunes" (Figure 3-2).

The extent of the foredune community has been greatly reduced from its historic distribution, and the community is now rare in California.

Dune Scrub (DS)

Dune scrub is a shrub-dominated community of inland dunes. The largest remaining patches of dune scrub occur on the bluffs below Lincoln Boulevard south of Battery Crosby, between Lincoln Boulevard and Washington Boulevard, on the south side of Washington Boulevard, on sites north of Lobos Creek, and on sites east of the Public Health Service Hospital's north parking lot. Smaller patches of dune scrub occur at the southeast corner of the Presidio. Dominant species in the dune scrub are mock heather, golden yarrow, bush monkeyflower, coyote brush, bush lupine, chamisso lupine, poison-oak, prostrate California coffeeberry, and California blackberry.

Short-statured, multitrunked coast live oak trees can dominate the cover in what is otherwise dune scrub habitat. These areas have been mapped as oak woodland (Figure 3-2) but could be considered either a subtype of dune scrub or a separate community altogether.

Early successional stages of dune scrub appear following disturbance of the sandy substrate. Vegetative cover is low with much open sand between plants. Early-succession vegetation is dominated by herbaceous species such as non-native bromes, wild oats, filaree, ice plant, native California poppy, San Francisco lessingia, sandmat, and blue-head gilia. Coast buckwheat and California croton are some of the earliest native perennials to establish.

Following dune disturbance at some sites, non-native ice plant or non-native grasses can dominate the cover. At sites where ice plant, ripgut brome, or soft chess has overwhelmed the native species, the community is categorized as "ice plant mats and non-native grasses on dunes" (Figure 3-2).

The extent of the dune scrub community has been greatly reduced from its historic distribution, and it is a rare community in California.

Bluff Scrub (BS)

Bluff scrub occurs on steep, ocean- and bay-exposed bluffs. The largest patches of bluff scrub are between the north end of Baker Beach and Fort Point. Vegetative cover may be sparse to dense depending on the steepness of the slope. Dominant species are California blackberry, prostrate blue-blossom ceanothus, poison-oak, and toyon. The species composition of bluff scrub is very similar to that of coastal scrub, with differences being the steeper slopes and lower vegetative cover of bluff scrub. Much of the area mapped as bluff scrub (Figure 3-2) is on serpentine soils and could support inclusions of serpentine chaparral.

Coastal Scrub (CS)

Coastal scrub is a shrub-dominated community of the gentler slopes above the bluff scrub and in inland areas. The largest patches of coastal scrub are on the west side of Lincoln Boulevard between Battery Crosby and Fort Point and on the north-facing slopes below Battery East Road. Dominant species in coastal scrub are California blackberry, poison-oak, prostrate blue-blossom ceanothus, prostrate and erect coyote brush, golden yarrow, toyon, and arroyo willow. Much of the area mapped as coastal scrub (Figure 3-2) is on serpentine soils and could support inclusions of serpentine chaparral.

Serpentine Chaparral (SC)

Serpentine chaparral is a shrub-dominated habitat of serpentine outcrops with shallow soils. Serpentine chaparral occurs south of the World War II Memorial on either side of Lincoln Boulevard, and scattered patches may occur within areas mapped as bluff and coastal scrub. Dominant species of serpentine chaparral are toyon, blue-blossom ceanothus, and coyote brush. Raven's manzanita may have been historically dominant in this habitat.

Sites within serpentine chaparral that have been naturally or artificially denuded of soil can be classified as "serpentine barren". Serpentine barren areas appear to provide the best habitat for Presidio clarkia and Marin dwarf flax. Serpentine barren areas occur within serpentine chaparral on road cuts and steep coastal bluffs.

Serpentine chaparral is a community of limited extent that supports many rare plant species.

Coastal Prairie (CP)

Coastal prairie is a grass- and herb-dominated community of well-developed soils on coastal terraces. Although it may historically have been a dominant habitat at the Presidio, only one large patch of coastal prairie remains, located inland on the east side of Arguello Boulevard. Dominant native species are purple needlegrass, foothill needlegrass, and California oatgrass. Many non-native

grasses occur in the coastal prairie, including wild oats, slender oats, ripgut brome, soft chess, and velvet grass.

Serpentine Prairie (SP)

Serpentine prairie is a grass- and herb-dominated community of well-developed serpentine soils. Serpentine prairie occurs on sites north and east of Inspiration Point. Dominant cover is similar to that of coastal prairie with purple needlegrass and foothill needlegrass, but serpentine-endemic species such as Presidio clarkia and Marin dwarf flax occur here as well.

As with serpentine chaparral, sites within serpentine prairie that have been naturally or artificially denuded of soil can be classified as "serpentine barren". Serpentine barren areas within serpentine prairie occur near Inspiration Point at the quarry, on road cuts, and on steep slopes.

Serpentine prairie is a rare community and supports some of California's rarest plant species.

Freshwater Marsh (FM)

Freshwater marsh is an herbaceous plant community that occurs at sites with perennial flooding or soil saturation in the root zone. Freshwater marsh occurs around the edges of Mountain Lake and freshwater marsh is dominated by tules and cattails.

Freshwater Seep

Freshwater seep is an herbaceous plant community that occurs at sites with seasonal or perennial soil saturation resulting from groundwater seepage. Freshwater seep occurs at a few scattered locations on the Presidio and is dominated by rushes and sedges.

Live Oak Riparian Forest (OR)

Live oak riparian forest is a stream- or lake-associated community dominated by dense stands of coast live oak. Along perennial streams, live oak riparian forest occurs above the willow riparian zone. The understory is usually more dense than that found under oak woodland. Live oak riparian forest on the Presidio occurs adjacent to Lobos Creek. The understory is mostly degraded by a dense cover of English ivy.

Arroyo Willow Riparian Forest (WR)

Arroyo willow riparian forest is a stream- or lake-associated community dominated by arroyo willow, often in dense, pure stands. The largest stands of arroyo willow riparian forest occur along

Lobos Creek and near Mountain Lake. Scattered small patches occur in the eastern portion of the park. Arroyo willow riparian forest occurs in the wettest portions of streambanks and lakesides, below the zone where live oak riparian forest establishes.

Riparian Scrub (RS)

Riparian scrub is a stream- or lake-associated community dominated by a variety of shrubs. The dominant cover is a mix of large shrubs and small trees and may include blue-blossom ceanothus, California wax-myrtle, red elderberry, coyote brush, and arroyo willow. Riparian scrub usually occurs along steep-banked streams or canyon sides.

Live Oak Woodland (OW)

Live oak woodland occurs in moist, sheltered sites away from the immediate coast. Only small stands of coast live oak occur at the Presidio, and the nature of their origin is uncertain. Live oak woodland is dominated by coast live oak. Typical oak woodland understory includes grass or shrub cover with poison-oak, toyon, coyote brush, California coffeeberry, and blue-blossom ceanothus.

Historically, other trees (such as buckeye, madrone, and California bay) may have occurred with coast live oak in live oak woodlands (Clarke 1959). If, at moist sites, madrone and California bay occurred as dominant or codominant trees, then these forests would have best been categorized as mixed evergreen forest (81100) (Holland 1986, 1990).

A stand of short-statured, multitrunked coast live oaks on stabilized dune soils northeast of the Public Health Service Hospital has been mapped as oak woodland (Figure 3-2). This habitat, however, is surrounded by dune scrub and supports an understory of dune scrub shrubs, such as mock heather, coast buckwheat, bush lupine, and bush monkeyflower. Wind-exposed oak stands on dune soils could be considered a subtype of either live oak woodland or dune scrub.

Non-Native, Non-Forest Plant Communities

The following sections describe the non-native, non-forest plant communities at the Presidio.

Non-Native Grassland (NG)

Non-native grassland is an herbaceous community dominated by non-native grasses with native and non-native forbs. Non-native grassland occurs at the Presidio on sites where native vegetation was removed and was not replaced with landscaping. Non-native grassland is dominated by ripgut brome, soft chess, slender oats, wild oats, wild barley, velvet grass, and filaree.

Ice Plant Mat (IP)

Ice plant mat is a community dominated by African ice plant, which often approaches 100% of the vegetative cover. Ice plant mat communities occur above Baker Beach, between Washington Boulevard and the Public Health Service Hospital, and north of Lobos Creek. Ice plant mat habitat dominates disturbed dune sites and can be found in areas that would have supported foredunes or dune scrub habitats. The habitat identified in Figure 3-2 as "ice plant mats and non-native grasses on dunes" includes the ice plant mat community and non-native grassland dominated by ripgut brome and soft chess that occur on sandy soils.

Special-Status Plant Occurrence

Definition of Special-Status Plant Species

Special-status species are plants and animals that are legally protected under the state and federal Endangered Species Acts (ESAs) or other regulations, and species that are considered sufficiently rare by the scientific community to qualify for such listing. Special-status plants are species in the following categories:

- plants listed or proposed for listing as threatened or endangered under the federal Endangered Species Act (50 CFR 17.12 [listed plants] and various notices in the Federal Register [proposed species]);
- plants that are candidates for possible future listing as threatened or endangered under the federal Endangered Species Act (61 FR 40: 7596-7613, February 28, 1996);
- plants listed or proposed for listing by the State of California as threatened or endangered under the California Endangered Species Act (14 CCR 670.5);
- plants listed as rare or endangered under the California Native Plant Protection Act (Cal. Fish and Game Code, Section 1900 et seq.);
- plants that meet the definitions of rare or endangered under the California Environmental Quality Act (CEQA) (State CEQA Guidelines, Section 15380);
- plants considered by the California Native Plant Society (CNPS) to be "rare, threatened, or endangered in California" (Lists 1B and 2 in Skinner and Pavlik 1994);
- plants listed by CNPS as plants about which more information is needed to determine their status and plants of limited distribution (Lists 3 and 4 in Skinner and Pavlik 1994), which may be included as special-status species on the basis of local significance or recent biological information; and

- plants listed as sensitive by the local U.S. Forest Service region (Forest Service Manual 2670) or U.S. Bureau of Land Management resource area.

Occurrences of Special-Status Species

The Presidio has been surveyed extensively for the occurrence of special-status plants by Jones & Stokes Associates (1990b), CNPS (ongoing), and NPS (Thomas 1986, National Park Service unpublished data). Special-status plant species known to occur at the Presidio are:

- Raven's manzanita,
- coast rock cress,
- Presidio clarkia,
- San Francisco wallflower,
- San Francisco gumplant,
- Marin dwarf flax,
- San Francisco lessingia,
- San Francisco owl's-clover,
- San Francisco campion,
- Franciscan thistle, and
- San Francisco spineflower.

These species' legal status is described in Table 3-2. Enhancement recommendations for Raven's manzanita, Presidio clarkia, Marin dwarf flax, San Francisco lessingia, and San Francisco campion are provided in Appendix I, "Rare Plant Enhancement Recommendations".

Raven's manzanita occurs on serpentine soils. Only one wild individual plant is known, and it grows on the Presidio (Jones & Stokes Associates 1990b). Cuttings from this plant have been planted and established at sites that have suitable soils.

Coast rock cress occurs in bluff scrub and coastal scrub communities. Populations occur in scattered locations at the Presidio (Thomas 1986).

Presidio clarkia occurs on serpentine barrens in serpentine chaparral and grassland habitats at the Presidio (Jones & Stokes Associates 1990b).

San Francisco wallflower occurs in foredune, dune scrub, bluff scrub, and coastal scrub communities at the Presidio (Thomas 1986).

San Francisco gumplant occurs in serpentine chaparral and on serpentine soils in bluff and coastal scrub communities at the Presidio (Jones & Stokes Associates 1990b, Thomas 1986).

Marin dwarf flax occurs on serpentine barrens in serpentine chaparral and grassland habitats at the Presidio (Jones & Stokes Associates 1990b, Thomas 1986).

Table 3-2. Special-Status Plant Species Known to Occur at the Presidio of San Francisco

Common Name	Scientific Name	Listing Status[a] Federal/State/CNPS
Raven's manzanita	*Arctostaphylos hookeri* var. *ravenii*	E/E/1B
Coast rock cress	*Arabis blepharophylla*	--/--/4
Presidio clarkia	*Clarkia franciscana*	E/E/1B
San Francisco wallflower	*Erysimum franciscanum*	–/–/4
San Francisco gumplant	*Grindelia hirsutula* var. *maritima*	–/--/1B
Marin dwarf flax	*Hesperolinon congestum*	T/T/1B
San Francisco lessingia	*Lessingia germanorum* var. *germanorum*	E/E/1B
San Francisco owl's-clover	*Triphysaria floribunda*	–/--/1B
San Francisco campion	*Silene verecunda* ssp. *verecunda*	–/--/1B
Franciscan thistle	*Cirsium andrewsii*	--/--/4
San Francisco spineflower	*Chorizanthe cuspidata* var. *cuspidata*	–/--/1B

[a] Status definitions:

- = no listing status.

Federal = U.S. Fish and Wildlife Service (50 CFR 17.12, 61 FR 40:7596-7613, February 28, 1996):

E = listed as endangered under the federal Endangered Species Act.
T = listed as threatened under the federal Endangered Species Act.

State = California Department of Fish and Game (1995):
E = listed as endangered under the California Endangered Species Act.
T = listed as threatened under the California Endangered Species Act.

CNPS = California Native Plant Society (Skinner and Pavlik 1994):
1B = List 1B species: rare, threatened, or endangered in California and elsewhere.
4 = List 4 species: plants of limited distribution.

San Francisco lessingia occurs in early successional dune scrub habitat. This species is endemic to the San Francisco Peninsula. Populations occur at five Presidio sites (Jones & Stokes Associates 1990b).

San Francisco owl's-clover occurs in serpentine chaparral. One population occurs at the Presidio (Thomas 1986).

San Francisco campion occurs in dune scrub habitat. Two populations are known at the Presidio (Jones & Stokes Associates 1990b, Thomas 1986).

Franciscan thistle occurs on wet sites in bluff scrub and in serpentine habitats. Populations are known to occur at the Presidio (Thomas 1986).

San Francisco spineflower occurs in sandy openings in dune scrub. Populations are known to occur at the Presidio (National Park Service unpublished data).

ADAPTATION OF INTRODUCED FOREST

As described in Chapter 2, "Natural Resource History", most of the existing Presidio forest was planted and its original distribution was part of a comprehensive landscape design plan. Exceptions are the native oak and willow stands along creeks and draws that were incorporated unchanged into the landscape plan.

Introduced Forest Species

The original species list of the Presidio's introduced historic forest is extensive, but only a few of these introduced species have survived. Five species now make up 95% of the forest: Monterey cypress, Monterey pine, blue gum eucalyptus, blackwood acacia, and coast redwood. During afforestation, most stands were planted with only one species. Monotypic stands still prevail, although a few such stands now exhibit some tree species diversity.

Monterey cypress, Monterey pine, and coast redwood are native to the California central coast but not to the Presidio, and blackwood acacia and blue gum eucalyptus are native to the southern Australian coast and Tasmania. Although some of these species are restricted to very limited areas in their native habitats, all five species have been used extensively in coastal, Mediterranean-type climates throughout the world for landscaping and forest development.

Reproductive Patterns of Introduced Species

Monterey cypress and Monterey pine are fire-responsive species, reproducing most successfully in their native environments after a fire occurs (Vogl et al. in Barbour and Major 1977). Heat from the fire opens their cones, bares mineral soil, eliminates competing vegetation, and opens the canopy to admit full sunlight. Seedling densities after fire are initially enormous, and if openings are large enough to admit sufficient sunlight (e.g., at least 0.25 acre for pine), the trees grow quickly to reoccupy the burned areas. They have relatively short life spans (70-120 years), however.

Monterey cypress reproduces significantly only after the cones are subjected to heat from fire, and fire in natural cypress stands is sometimes stand-destroying. Successful cypress reproduction in its natural habitat is restricted to burned sites; other chance reproduction cannot be expected to perpetuate stands.

Monterey pine releases a moderate amount of seed from its cones from time to time between fires, but fire produces much more seed. In its natural habitat, fire in mature pine stands often burns the forest floor without destroying the stand. Without fire, cones open and close during hot periods, resulting in a constant but meager seed rain and modest reproduction.

The Australian trees, blue gum eucalyptus and blackwood acacia, reproduce both under a canopy and in available openings. Both trees can regenerate either from seed or by sprouting from stumps and roots. They also impede growth of most competing vegetation through chemicals exuded by their leaf litter (Hall et al. 1962).

Redwoods, which occur on the Presidio only in sheltered areas with deep soils, reproduce by stump sprout or seed germination, although the seeds often have a poor germination rate (Harlow et al. 1978).

Natural Regeneration of Surviving Introduced Forest Species

As in their natural habitats, planted Monterey cypress and Monterey pine at the Presidio have not reproduced well under their own canopies. In many of these stands, however, the groundcover is mowed or maintained in a parklike condition. Occasionally, young pines and cypresses establish successfully at locations on the Presidio, most frequently in natural plant communities adjacent to the planted forest stands.

Planted eucalyptus and acacia, on the other hand, have reproduced well under their own canopies where light has been adequate. More than half of the original eucalyptus stands have expanded from their original planting sites. Acacias have colonized more rapidly; in some cases, stands have migrated considerable distances and completely abandoned their planting sites.

A brief survey of natural regeneration of Monterey cypress and Monterey pine at the Presidio was conducted to help in formulating this plan. The following observations represent an overall impression of the relative significance of various factors in promoting or limiting regeneration. The factors considered were drawn from a literature survey and discussions with knowledgeable individuals. (Two possible factors not evaluated in this survey are the possibility that some cones are producing unviable seeds, and the importance and presence of mycorrhizal associations in Presidio soils.)

Regeneration is completely lacking in many forest stands, but many other stands show some regeneration (refer to Appendix D, "Updated Forest Stand Inventory", for more information). Most regeneration is occurring among pine stands; relatively little regeneration is occurring among cypress. Overall, a wide range of seedling and sapling age classes is present. Regeneration is occurring in several stands in which fire is apparently not a factor, and one stand that was subject to a recent fire is not regenerating. Soil type does not appear to be a key factor in regeneration.

Cones are produced in great abundance in all stands and are of normal size. Even though fire is rarely present at the Presidio, many of the pine cones and some of the cypress cones are open, both on the tree and on the ground. Depending upon humidity, cones open in the summer when the temperature exceeds about 85°F, as indicated by a popping sound heard on such days.

The few areas of bare soil at the Presidio have been subject to repeated disturbance and generally do not show regeneration. Most areas of regeneration have a forest-litter layer, generally 1-6 inches deep. Litter layers tend to be more shallow under Monterey cypress than under pine, and less regeneration occurs there as well. Many seedlings and saplings (mainly pine) are growing well in a dense grass cover, especially where the grass has been mowed.

Pine and cypress regeneration is occurring within eucalyptus stands, with some trees growing in thick eucalyptus litter. Allelopathy, if present, apparently does not exclude pine and cypress establishment.

Regeneration is more likely on the edges of or adjacent to stands rather than within stands, but some regeneration also occurs within stands, especially of cypress. Some regeneration occurs in partial openings within stands; in other places, regeneration occurs under dense canopy cover. A few large, open areas have regeneration, but most do not. Although regeneration may be found throughout the Presidio, it may be greatest nearer to the ocean.

Regeneration occurs on a variety of topographic aspects, with a notable lack of regeneration on some southerly slopes. During summer, fog drip from foliage of mature trees occurs frequently, probably contributing a significant amount of soil moisture. Given the low moisture storage capacity of the widespread sandy dune soils, this moisture may be critical to seedling establishment in the dry summer climate. Regeneration appears to be relatively high under the canopy of mature trees or near driplines adjacent to canopy openings.

Understory and Groundcover

Shrub species planted as windbreaks and dune stabilizers (leptospermum, photinia, beefwood, melaleuca, ceanothus, and lupine) are, for the most part, no longer present. The plants either became senescent and died, were shaded out, or were removed by U.S. Army staff.

The understory of most Monterey pine and Monterey cypress stands has been limited to grasses and forbs by frequent mowing and, at least under cypress, by dense canopy shading.

Groundcover varies greatly under the eucalyptus, depending on the seed productivity of associated vegetation, maintenance by the Presidio staff, canopy density, and litter accumulation. On soils derived from weakly cemented surficial deposits (the Colma Formation), German ivy, Himalaya berry, and holly dominate the understory. On ultrabasic soils derived from serpentine, native trees such as toyon and hollyleaf cherry are found with ivy and blackberries in the understory. On the dune sands, grasses, forbs, and a few blackberries constitute the understory.

The distribution of understory vegetation types throughout the forest is shown in Figure 3-3.

Naturalization

"Naturalized" stands are self-generating stands. At the Presidio, these are usually expansions of planted stands into adjacent open areas supporting nonforest native plant communities or weedy annuals. Several naturalized stands of Monterey pine, Monterey cypress, and eucalyptus have invaded valleys and vista areas that were intended to remain unwooded under the original forest plan.

Naturalized stands vary greatly in species composition, age, health, and size. Because they have colonized adjacent areas gradually and without management, most of these mixed stands are structurally diverse. Some naturalized stands are mixed pine and cypress, usually dominated by pine. Most naturalized eucalyptus stands are monotypic.

Survival of Key Stands within the Historic Forest

Many of the surviving stands are of historical interest today. In particular, the original entryway plantings are present at the Lombard Street, Arguello Boulevard, and Presidio Boulevard entrances. A stand of eucalyptus along Presidio Boulevard planted in a perfect grid demonstrates "the power of government", as Major Jones intended. The northernmost stands of the ridge windbreak system, near the historic stables, are particularly fine examples of these stands at maturity, and the windbreak stands immediately adjacent to the early buildings of the main post still serve their function.

Survival of Native Woodland

Native willow, wax myrtle, and oak stands have persisted only in the riparian areas adjacent to Lobos Creek and Mountain Lake. Native toyon and hollyleaf cherry grow in isolated pockets under the canopies of the eucalyptus.

PRESENT FOREST CHARACTER

Measurements of forest structure and form at the Presidio, describing a variety of forest stand characteristics, were made in 1984 (McBride 1984). These data, based on the delineation of 235 individual stands and updated by the American Society of Landscape Architects in 1986 and Jones & Stokes Associates in 1994 (Figure 3-4), provide a quantitative basis for some of the conclusions drawn in this chapter.

A "stand" is a group of trees possessing sufficient uniformity in species composition, structure, arrangement, age, and condition to be distinguishable from adjacent groups. As described in Chapter 2, "Natural Resource History", most of the stands present at the Presidio were planted, although a few stands comprise native woodland. Most are monotypic. The inventory data, as updated by Jones & Stokes Associates remapping, appear in Appendix D.

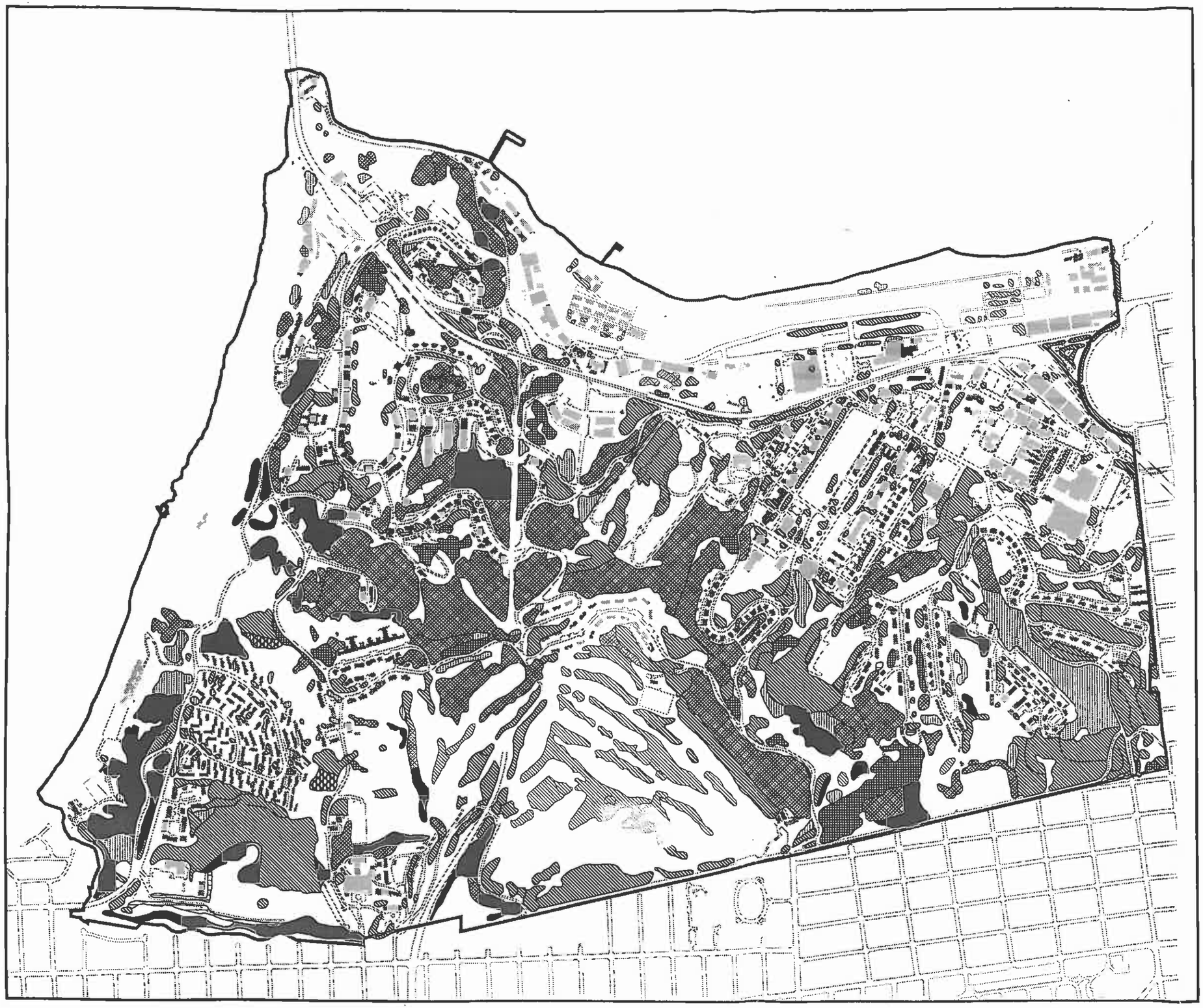
Species Composition and Growth

In 1984, the Presidio forest contained about 3.5 million cubic feet of wood in 70,000 trees, distributed primarily among monotypic stands of eucalyptus, Monterey cypress, and Monterey pine.

Eucalyptus stands dominate the Presidio forest, covering 42% of the forested acreage (Table 3-3). The eucalyptus contributes more than 40% of the forest's total wood volume. Cypress stands, although somewhat less extensive (34%), make a contribution to total wood volume equal to that of the eucalyptus. The pine and mixed-species stands occupy 17% of the forest, providing 14% of the volume.

Tree volumes are affected by substrate conditions, but the effects are species dependent (Figure 3-5). On the drought-susceptible and nutrient-poor dune sands, for example, cypress growth appears somewhat suppressed, but eucalyptus and pine growth rates are approximately normal for these species. Acacia volumes are relatively high on the dune sands. On the serpentine soils, tree species tend to grow poorly if at all. The principal exceptions are eucalyptus and Monterey pine, which appear to grow moderately well.

FIGURE 3-3. UNDERSTORY VEGETATION OF FOREST STANDS



- Sensitive areas: Wetlands or Rare and Endangered Plants
- Native Trees and Shrubs
- Native Grasslands, Forbs, Herbs, Trees, and Shrubs
- Mixed Non-Native and Native Grasslands, Forbs, Herbs, Trees, and Shrubs
- Mixed Non-Native and Native Trees and Shrubs
- Mixed Non-Native and Native Grasslands, Forbs, and Herbs
- Non-Native Plant Species

Source: Staff and volunteers of the Natural Resources Division of the Golden Gate National Recreation Area

Scale 1" = 1000'

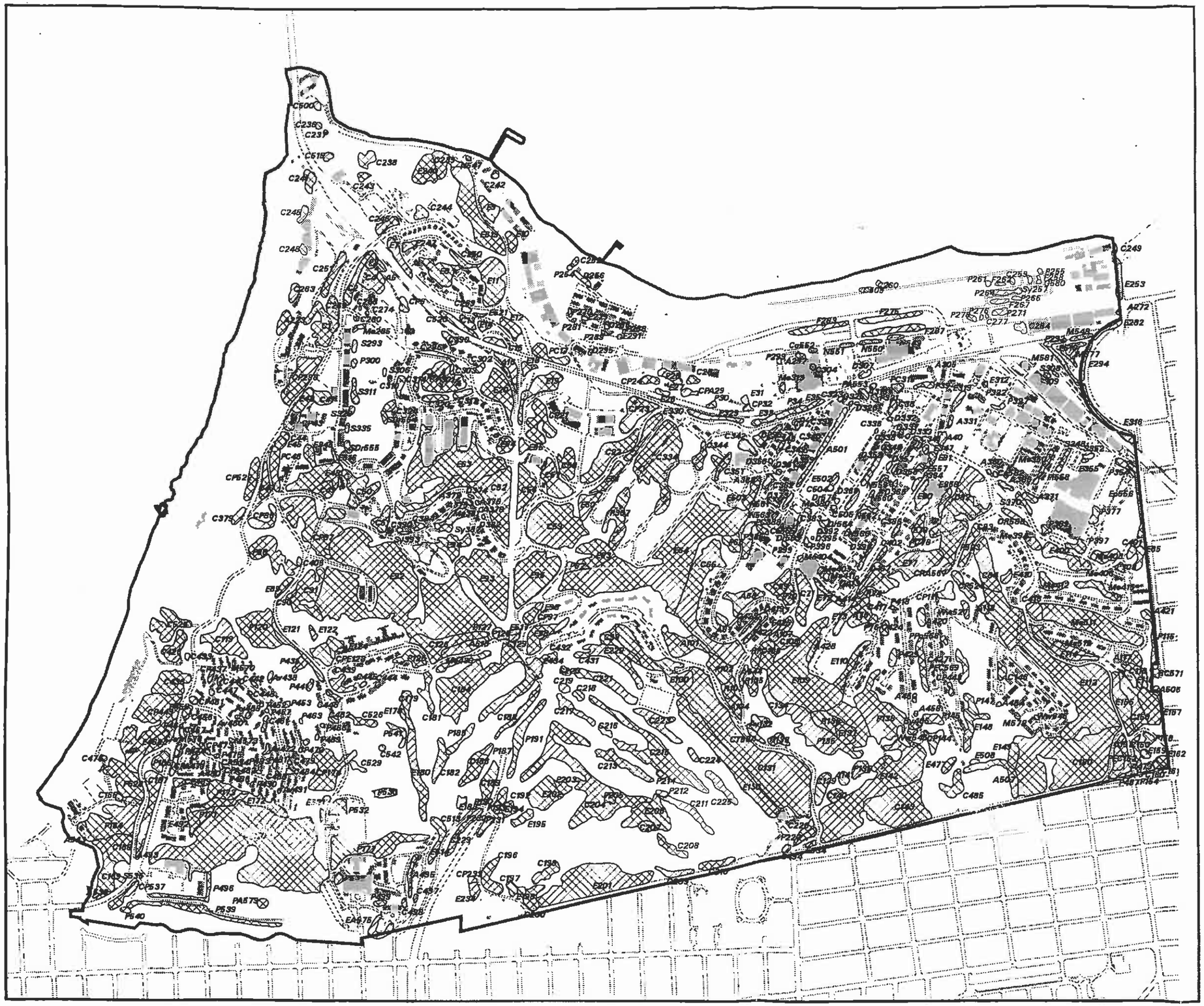
0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

14-Nov-94

ovegrate-f.aml

FIGURE 3-4. FOREST STANDS



FOREST STANDS

A	BLACK ACACIA
Av	ACACIA VERTICILLATA
C	MONTEREY CYPRESS
Ce	CASUARINA
Ce	CEDAR
D	DATE PALM
Dr	DRACAENA
E	EUCALYPTUS
F	FAN PALM
G	GIANT SEQUOIA
M	MYOPORUM
Me	MIXED EVERGREENS
N	NEW ZEALAND CHRISTMAS TREE
O	COAST LIVE OAK
P	MONTEREY PINE
Pi	PITTOSPORUM
Po	POPLAR
R	REDWOOD
S	STONE PINE
Sy	SYCAMORE
T	TOYON
Ww	WEEPING WILLOW

Stand numbers 1 to 235 from McBride 1984, and stand numbers 236 to 585 from Jones & Stokes Associates. Some boundary adjustments have been made by the American Society of Landscape Architects and Jones & Stokes Associates.

Scale 1" = 1000'

0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

2-May-95

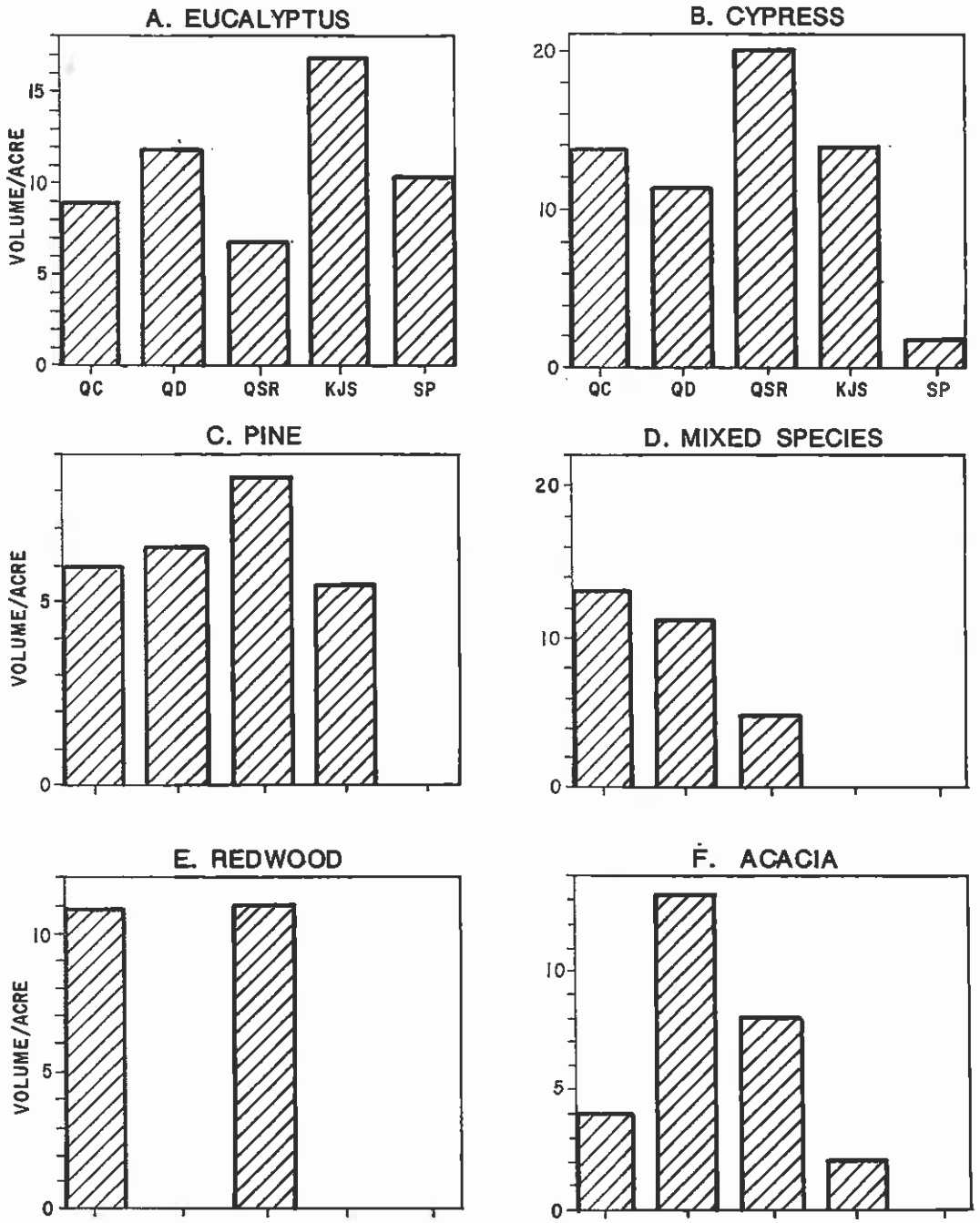
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Table 3-3. Tree Species Distribution by Area, Number of Trees, and Wood Volume

Species	Acreage % of Forest Stands[a]	Number of Trees % of Forest Stands[a]	Wood Volume % of Forest Stands[a]
Eucalyptus	42	31	42
Cypress	34	24	42
Pine and mixed	17	16	14
Willow	3	23	<1
Redwood	1	1	1
Acacia	2	5	1
Oak and other	1	1	<1

Note: Data are based on a partial survey of the Presidio forest (McBride 1984); actual percentages may be slightly different than those shown.

[a] Percentages may not total 100 due to rounding.



LEGEND

QC ANCIENT DUNE DEPOSITS	KJS SANDSTONE AND SHALE
QD DUNE SAND	SP SERPENTINE
QSR COLLUVIUM	

Notes: Volume Units Are Thousands of Cubic Feet. Data Are Based on a Partial Survey of Presidio Forests (McBride 1984) and on Information Presented in Figure 3-1a.

FIGURE 3-5. SPECIES VOLUME-DENSITY IN RELATION TO SUBSTRATE

Stand Structures

Because most of the Presidio forest was planted during a relatively short period, the introduced forest is essentially of a single age class ("same aged" or "even aged"). The native stands, however, tend to be of several age groups, or "uneven aged".

Even-Aged Stands

Because little reproduction is occurring within the introduced stands, a classical even-aged forest has resulted. Even-aged stand structures are natural for Monterey pine and Monterey cypress, which usually require a fire to reproduce. Because most of the planted forest is approximately the same age, the forest has matured uniformly, and a period of high mortality is beginning in the cypress and pine stands.

Eucalyptus in its native environment is also considered to form even-aged stands (Hall et al. 1962). Although the Presidio eucalyptus stands were originally even aged, they appear to be evolving into uneven-aged stands.

Uneven-Aged Stands

The naturalized eucalyptus stands exhibit uneven-aged structures, as noted above. A few Monterey pine and Monterey cypress stands exhibit an uneven-aged character, probably because of replanting or subsequent planting of earlier openings within the stands.

The native willows and oaks in the Lobos Creek area form uneven-aged stands. Because oak regeneration at the Presidio has had limited success, however, the oak stands are tending toward an even-aged, old-growth structure. The willows have the classical uneven-aged pattern: many young trees and few old trees. Willows are relatively short lived, but they reproduce prolifically.

The Monterey cypress and Monterey pine stands that have naturalized and expanded into open spaces have a mix of ages and will continue as uneven-aged stands for several more decades. Once canopies close, stands will probably evolve into an even-aged structure.

Pathogenic Influences

The Presidio forest is subject to several pathogenic influences: insects, biotic diseases, abiotic diseases, and weeds. Abiotic diseases are one of the primary problems facing urban forest managers but are the least understood and diagnosed. Most senescence and tree deaths in the Presidio forest exhibit evidence of insects and diseases.

The following sections describe the pathogenic influences in the Presidio forest, closing with a discussion of major pathogenic problems that may arise during future forest management.

Insects

Many species of insects are constantly at work in forests. A few species periodically become epidemic and kill trees over extensive areas. This has not occurred at the Presidio.

For every tree species, specific insects attack either the roots, bole, branches, needles or leaves, or cones or seeds. Particularly destructive insects on the Presidio are noted in Table 3-4 by species and tree part affected. The insects that can become epidemic are described in more detail in Appendix F, "Important Forest Insects at the Presidio".

Most of the insects listed in Table 3-4 are endemic to the forest but normally occur in numbers too limited to attack healthy trees successfully. When stress stemming from advanced age and disease triggers a decline in tree vigor, the insects can irrupt and cause serious losses. As the Presidio forest becomes older and more decadent, the incidence of debilitating insect attacks will probably increase (Smith, Stephen pers. comm.).

Biotic Diseases

Biotic tree diseases include mistletoes, bacteria, fungi, and viruses (Bega 1978). Since the forest was planted at the Presidio, few of the diseases common to the various tree species in their native habitats have become established at the Presidio.

Tree diseases usually move through a forest more slowly than insects, but once established, they often persist, creating long-term problems. Wind and water are the most common vectors of disease transport, but insects also transport some diseases. Accurate disease diagnosis depends on identifying symptoms and studying occurrence patterns.

Debilitating diseases usually occur in older trees. An example is *Polyporus basilaris*, a heart rot that occurs in 80% of Monterey cypress trees 65 or more years old throughout this species' range (Bega 1978). Trees less than 30 years old are usually rot free.

Root diseases are difficult to diagnose, yet can cause serious damage to trees. These diseases are generally nourished by landscaping irrigation, which is widespread at the Presidio. Root diseases, primarily armillaria, attack all of the major tree species at the Presidio and pose the most dangerous pathogenic problem to the forest.

As with insects, specific diseases affect specific parts of each tree species. The most common diseases are listed in Table 3-5, and the symptoms of the most critical diseases are described in Appendix G, "Important Forest Diseases at the Presidio".

Table 3-4. Significant Insect Pests of the Presidio Forest

Insect	Tree Part Affected	Frequency of Occurrence on Presidio	Likelihood of Tree Mortality if Infested
Monterey Pine			
Monterey pine cone beetle (*Conophthorus radiatae*)	Cones	High	Low[a]
Western pine spittlebug (*Aphrophora permutata*)	Twigs and needles	Moderate	Moderate
Tent caterpillar (*Halisidota argentata-sobrina*)	Needles	Moderate	Low order Lepidoptera Fam. Arctiidae
Monterey pine needleminer (*Argyasthia pilatella*)	Needles	Moderate	Low
Monterey pine weevil (*Pissodes radiatae*)	Bark and tips	Moderate	Low
Sequoia pitch moth (*Vespamima sequoiae*)	Bark	Low	High
Red turpentine beetle (*Dendroctonus valens*)	Bark	Moderate	High
Ips (*Ips* sp.)	Bark	Low	High
California flatheaded borer (*Melanophila californica*)	Boles and limbs	Low	Moderate ~~Order~~
Monterey Cypress			
Cypress bark moth (*Laspeyresia cupressaria*)	Cones and twigs	Moderate	Moderate
Cypress tipminer (*Argyresthia cupressella*)	Twigs	Moderate	Low Order Lep ~~Fam~~ Yponomeutidae
Cypress leaftier (*Epinotia subviridis*)	Needles and twigs	Moderate	Low
Cypress bark beetle (*Phloeosinus custatus* and *P. cupressi*)	Bark	Moderate	Moderate[b] order Coleoptera Fam Scolytidae
Blue Gum Eucalyptus			
Eucalyptus longhorn borer (*Phoracantha semipunctata*)	Bark	Not present	High
False powderpost beetle (*Polycaon stoutii*)	Deadwood	Moderate	Low
Coast Live Oak			
California oak worm (~~*Phryganiotta*~~ *californica*) moth Phryganidia	Leaves	Moderate	Moderate Order Lep Fam Dioptidae
Pit scale (*Asterolecanium minus*)	Twigs	Moderate	Low Homoptera Asterolecaniidae
Western tussock moth (*Orgyia vetusta*)	Twigs	Low	Moderate
Orange tortrix (*Argyrotae citana*)	Leaves	Low	Unknown
Coast Redwood			
Redwood bark beetle (*Phloeosinus sequoiae*)	Bark	Not present	Moderate

[a] Usually results in mortality only in conjunction with pine pitch canker, which is not known to occur on Presidio.
[b] Usually results in mortality only in conjunction with cypress canker, which occurs with moderate frequency on the Presidio.

www.fungiweb.com/searchtree.html

Table 3-5. Significant Biotic Tree Diseases of the Presidio Forest

Disease	Species Affected	Tree Part Affected	Frequency of Occurrence on Presidio	Likelihood of Tree Mortality if Infested
Bole and Root Diseases				
Armillaria root disease (*Armillaria mellea*)	All	Root	Moderate	High
Annosus root disease (*Fomes annosus*)	Conifer	Root	Low	High
Shelf fungus (*Fomes applanatus*)	Hardwoods	Root	Moderate	High
"Velvet top" fungus (*Polyporous schweinitzii*)	Oak, eucalyptus, pine	Root	Low	Moderate
Water molds (*Phytophthora* spp.)	Hardwoods	Root	Moderate	Moderate
Crown gall (*Agrobacterium* spp.)	Oak, eucalyptus	Root	Low	Low
Western gall rust (*Peridermium harknessii*)	Pine	Bole	Moderate	Moderate
Cypress canker (*Coryneum cardinale*)	Cypress	Bole	Moderate	High
Pine pitch canker (*Fusarium subglutinans*)	Pine	Bole	Not present	High
Oak wilt (*Ceratocystis fagacearum*)	Oak	Bole	Not present	High
Heart Rots of Boles and Limbs				
White pocket rot (*Fomes pini*)	Pine	Bole	Moderate	High
Cypress heart rot (*Polyporus basilaris*)	Cypress	Butt	High	High
Sulfur fungus (*Polyporus sulphureus*)	Eucalyptus, oak	Bole	High	Moderate
Brown cubical rot (*Poria sequoiae*)	Redwood	Bole	Low	Low
Tinder fungus (*Fomes igncarius*)	Eucalyptus, oak	Butt	Low	Moderate
Red belt fungus (*Fomes pinicola*)	Pine	Bole	Low	Low
Large branch dieback (*Diplodia quercina*)	Oak	Limb	Not present	Moderate
Twig blight (*Cryptocline cinerescens* and *Discula quercina*)	Oak	Limb	Low	Low
Leaf and Needle Diseases				
Needle cast (*Lophodermium pinastri*)	Pine	Canopy	Moderate	Low
Red band needle blight (*Scirrhia pini*)	Pine	Canopy	Moderate	Low
Powdery mildew (*Spaerotheca lamestris*)	Oak	Canopy	Moderate	Moderate
Anthracnose (*Gnomonia* spp.)	Hardwoods	Canopy	High	Low
Dwarf mistletoe and true mistletoe (*Arceuthobium* spp. and *Phoradendron* spp.)	All	Canopy	Low	Low

Abiotic Disease Agents

Natural abiotic, or nonliving, disease factors on the Presidio are wind (having both mechanical and physiological effects), salt, drought, soil erosion, dune movement, mineral deficiency (in dune sands), toxic mineral concentrations (as from serpentine substrate), prolonged high and low temperatures, fire, and animal damage.

Saline wind constantly prunes the forest, especially the redwoods, oaks, and cypress. After heavy rainfall in the early 1980s, an unusual wind struck the Presidio, uprooting 600 trees. In early winter 1988, a strong north wind blew down 200 trees. Low temperatures caused losses in the mid-1970s when a snowstorm caused widespread injury to eucalyptus tops.

Gophers are a problem in some of the Presidio's landscaped areas and in Golden Gate Park, where they are the most destructive factor affecting survival of native and ornamental plantings.

Human-caused abiotic disease agents on the Presidio are mechanical injury (mower and tractor damage), soil compaction, filling and excavating for construction, paving, root cutting, and pruning. These factors cause tree injury and occasional tree loss.

Weeds

Other pests of the forest are aggressive weeds that compete successfully for sunlight and soil moisture. Weeds can be especially competitive with tree seedlings and native plant communities. CNPS has developed a list of weeds that occur in San Francisco, identifying those that most severely threaten the native vegetation (Table 3-6).

Weeds include escaped landscaping plants such as German ivy, French and Scotch broom, and pampas grass. These species should not be used for landscaping on the Presidio.

Major Pathogenic Threats

Three new pests pose serious threats to the Presidio forest: the eucalyptus borer, pine pitch canker, and cypress canker.

Eucalyptus Borer. This insect is one of the most significant potential threats to the Presidio forest. It was formerly confined to the Los Angeles basin but was reported in Contra Costa and Alameda Counties in 1989. If a pest such as the eucalyptus borer enters the Presidio's older eucalyptus forest, significant losses could occur, reducing affected stands to patchy groups of young trees.

Pine Pitch Canker (Fungus). Pine pitch canker had its first outbreak in 25 years in the Monterey Bay area in 1987 and presently infects trees in five locations. The canker quickly spread to the San Francisco Bay Area for the first time, traveling by waterborne spores that infected state

Table 3-6. Weedy Species in San Francisco

Common Name	Scientific Name
Albizia	*Albizia lophantha*
Andean pampas grass	*Cortaderia jubata**
Australian fireweed	*Erechtites prenanthoides**
Bermuda buttercup	*Oxalis pes-caprae**
Bermuda grass	*Cynodon dactylon*
Black acacia	*Acacia melanoxylon*
Blue gum eucalyptus	*Eucalyptus globulus*
English ivy	*Hedera helix*
European beach grass	*Ammophila arenaria*
Everlasting pea	*Lathyrus latifolius*
French broom	*Cytisus monspessulanus**
German ivy	*Senecio mikanioides**
Giant reed grass	*Arundo donax*
Gorse	*Ulex europaeus**
Himalaya berry	*Rubus procerus*
Ice plant	*Carpobrotus edulis*
Myporum	*Myoporum laetum*
Periwinkle	*Vinca major*
Red valerian	*Centranthus ruber*
Round-leaf ice plant	*Conicosia pugioniformis*
Scotch broom	*Cytisus scoparius*
Sow thistle	*Sonchus oleraceus**
Spanish broom	*Spartium junceum*
Sidney golden wattle	*Acacia longifolia*

* Exceptionally invasive and threatening to native plant communities.

Source: Smith, Sue pers. comm.

highway plantings of Monterey pine along the way. A single infected tree was identified in San Francisco at the Harding Park Golf Course and was removed. Little is known about this new disease, except that it moves quickly and can ultimately kill the Monterey pine and other closed-cone (fire) pines, sometimes within a 3-month period. (California Department of Forestry and Fire Protection 1987.)

Some Monterey pines are relatively resistant to the effects of the pine pitch canker, but the source of their resistance is currently poorly understood. Where trees are killed, insects such as cone borers and bark beetles are often present with the canker. Researchers at the University of California note that the disease is currently uncontrollable. They are urging Californians not to plant additional Monterey pines until a more resistant strain is developed.

Cypress Canker (Fungus). The cypress canker limits the inland range of Monterey cypress in its native habitat. Where the climate is warm or dry, the fungus has virtually eliminated Monterey cypress from the landscape. Ocean spray is also believed to prevent the canker spore from germinating successfully (Vogl et al. in Barbour and Major 1977). Cypress bark beetles are often associated with this disease, hastening tree mortality.

The cypress canker is endemic to Golden Gate Park, and reforestation of dry, south-facing sites has been difficult. Where debilitating infections have occurred, Monterey cypress trees have been replaced with other species. If the canker continues to establish at the Presidio, it may become a problem for young trees in reforestation plots.

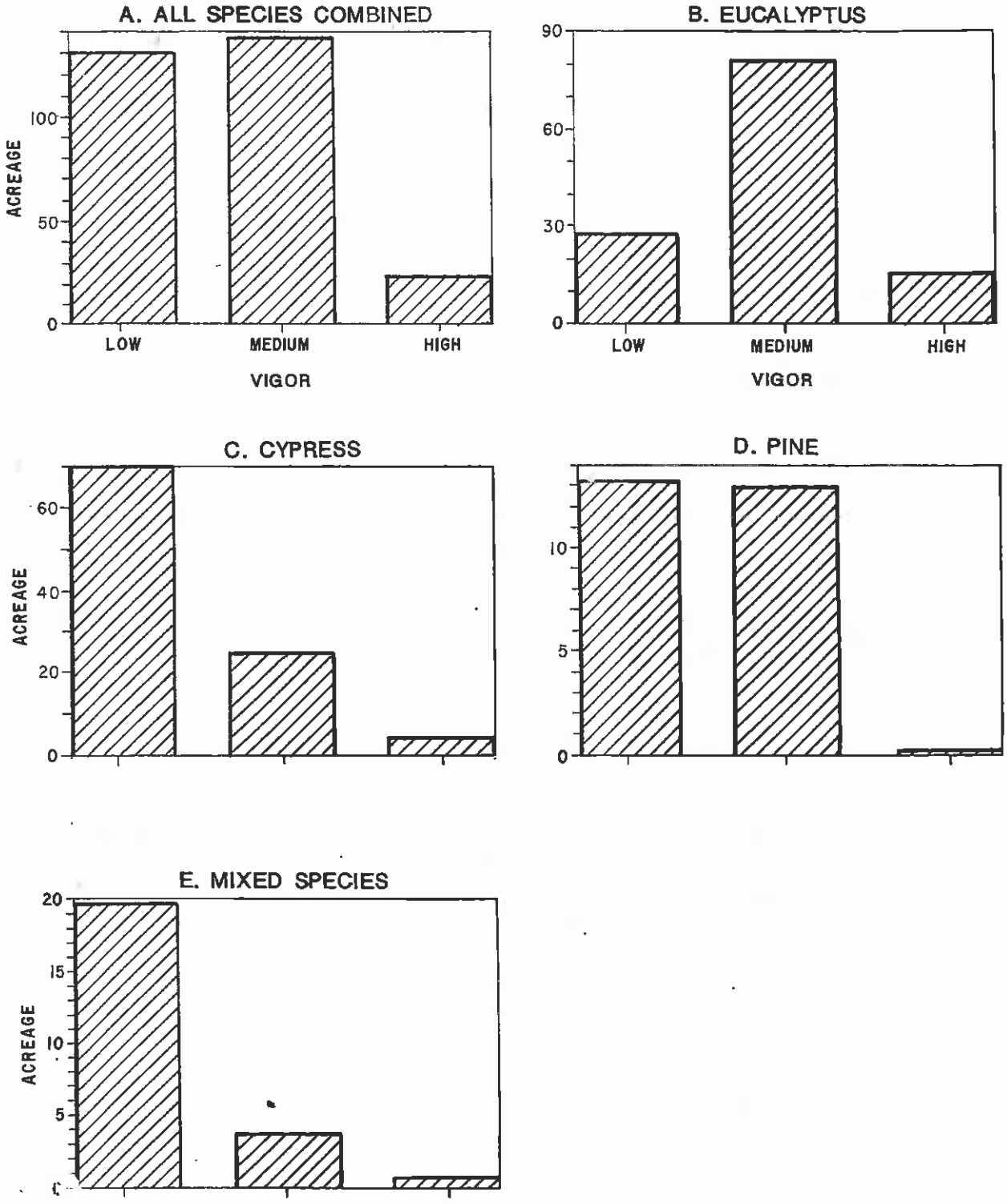
PRESENT FOREST CONDITION AND HAZARDS

In this section, the present stand vigor and the hazard posed by Presidio forest decadence are described. Stand vigor descriptions are based on a 1984 partial stand inventory (McBride 1984). A hazard tree inventory of the Presidio commissioned for this plan (Appendix B, "Tree Hazard Assessment and Hazard Tree Management Plan") is the basis for a summary of tree hazard conditions.

Forest Condition

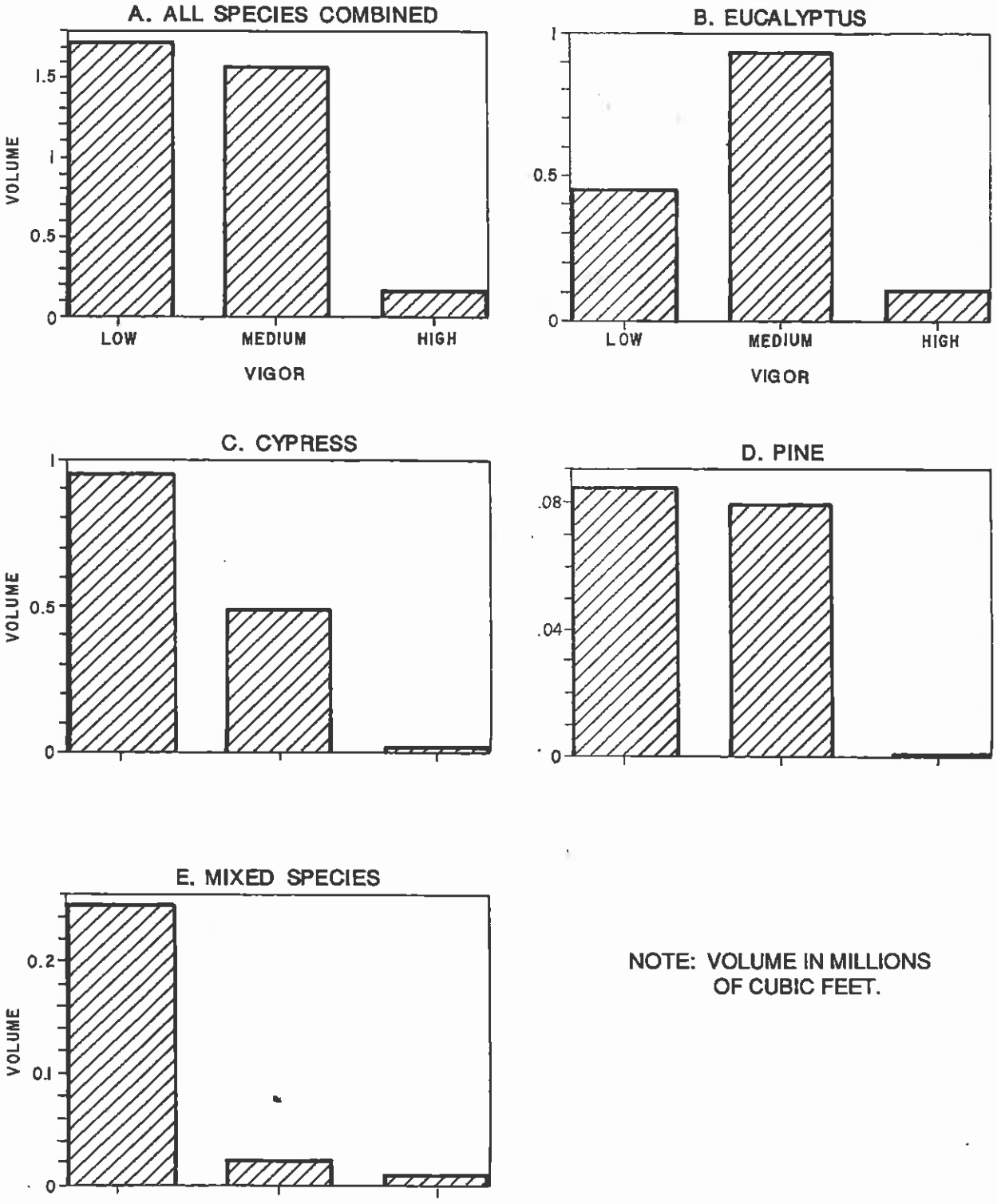
Much of the Presidio forest is in an obvious and serious state of decline. On an acreage basis, less than 9% of the forest stands exhibit high vigor, whereas 45% show low vigor (Figure 3-6). By total volume, only 5% of the forest exhibits high vigor, whereas 50% shows low vigor (Figure 3-7). Based on numbers of trees, this decline is less pronounced: 33% have low vigor (Figure 3-8).

The relative vigor of the eucalyptus stands is substantially higher than the forestwide average, but the cypress and mixed-species stands are much less vigorous. Based on volume, low vigor is



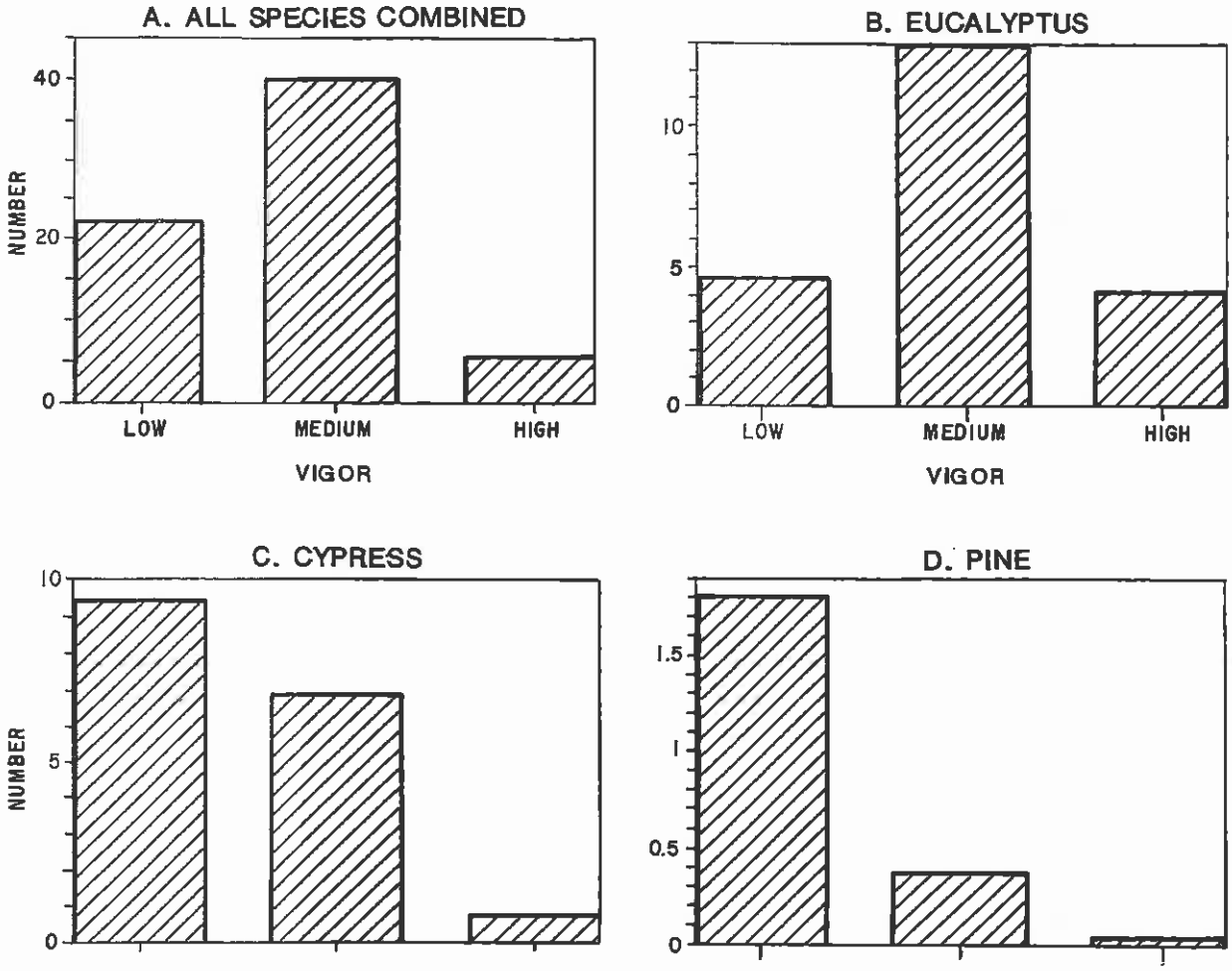
Note: Data Are Based on a Partial Survey of Presidio Forests (McBride 1984) and on Information Presented in Figure 3-1a.

FIGURE 3-6. FOREST CONDITION BY ACREAGE



Note: Data Are Based on a Partial Survey of Presidio Forests (McBride 1984) and on Information Presented in Figure 3-1a.

FIGURE 3-7. FOREST CONDITION BY WOOD VOLUME



Notes: Number Units Are Thousands of Trees. Data Are Based on a Partial Survey of Presidio Forests (McBride 1984) and on Information Presented in Figure 3-1a.

FIGURE 3-8. FOREST CONDITION BY NUMBER OF TREES

evident in 65% of the cypress stands, 51% of the pine stands, nearly 90% of the mixed-species stands, and 30% of the eucalyptus stands (Figure 3-7).

The cause of forest decline is not attributable to a particular pathogenic influence, stress factor, or soil factor; senescence is primarily the result of the advanced age of most trees.

In the absence of individual tree care, most trees with low vigor can be expected to live no more than another 10-20 years. Thus, without significant forest management, the Presidio forest could decline in extent by 45% by 2005-2015. The largest acreage loss would be in the cypress stands, although eucalyptus losses would also be substantial. Relative to their present abundance, losses of the mixed-species and cypress stands would be the most severe.

The volume of woody debris from trees now classified as decadent (low vigor) is 1.7 million cubic feet, about half of the present volume of all trees in the forest.

Hazardous Tree Occurrences

Character and Extent of Hazard Trees at the Presidio

"Hazardous" trees are landscaping trees that are growing around buildings or along roads and could injure people or damage vehicles or buildings. In this report, landscaping trees are generally distinguished from forest stands, although trees along stand perimeters are also often considered landscaping trees and accordingly may be considered hazardous.

Based on a partial survey conducted for this plan of the 7,000-8,000 landscaping trees at the Presidio (Britton Tree Services 1994, included as Appendix B), approximately 65% are potentially hazardous using NPS's hazard-tree rating system (Figure 3-9). Whereas only 717 landscaping trees were rated in the partial survey as potentially hazardous, a few thousand trees have been found potentially hazardous with recent completion of the inventory.

The numerical hazard rating system used by NPS (Western Regional Directive #WR-093 and 1993 Guidelines for Managing Hazardous Trees) reflects both the probability of tree failure, as estimated from tree-defect ratings, and the degree of human and property exposure to the hazard. Ratings may range from 2 to 7, and any tree with a rating of 4 or more is considered potentially hazardous. At the Presidio, 65% of the landscape trees have ratings of 4 or more, and 32% are rated 5 or more, in the partial survey.

Tree defects are rated as low, medium, or high. Of the trees inventoried, 26% had a high defect rating, indicating a predisposition to fail within 3 years.

Targets are also rated on a three-point system. About 21% of the potentially hazardous trees are over high-use, or continuously occupied targets. Historic buildings were found to be threatened

by at least 75 trees, and many of the targets at risk are playgrounds, yards, occupied residences, and roads.

The work needed to eliminate the tree hazards is varied. About 26% of the hazardous trees require removal, and the remaining 74% need pruning. A few trees (3%) can be preserved through thinning and cabling.

Species-Specific Hazards

Hazard trees are distributed among the species proportionately to the number of each species at the Presidio. About 33% of the potentially hazardous trees are Monterey cypress, 25% are Monterey pine, and 15% are blue gum eucalyptus.

An earlier hazardous tree inventory (Hermann Ziligens Associates 1988) estimated the degree of hazard that might be expected from a particular tree species and which parts of trees of each species are most likely to fail (Table 3-7). These data indicate that the blackwood acacia is the most hazard-prone species in the landscaped areas. The Monterey pine appears to have the lowest rate of potential failure. Pine failure, however, sometimes occurs at the roots or bole rather than the branches, magnifying the potential for serious damage.

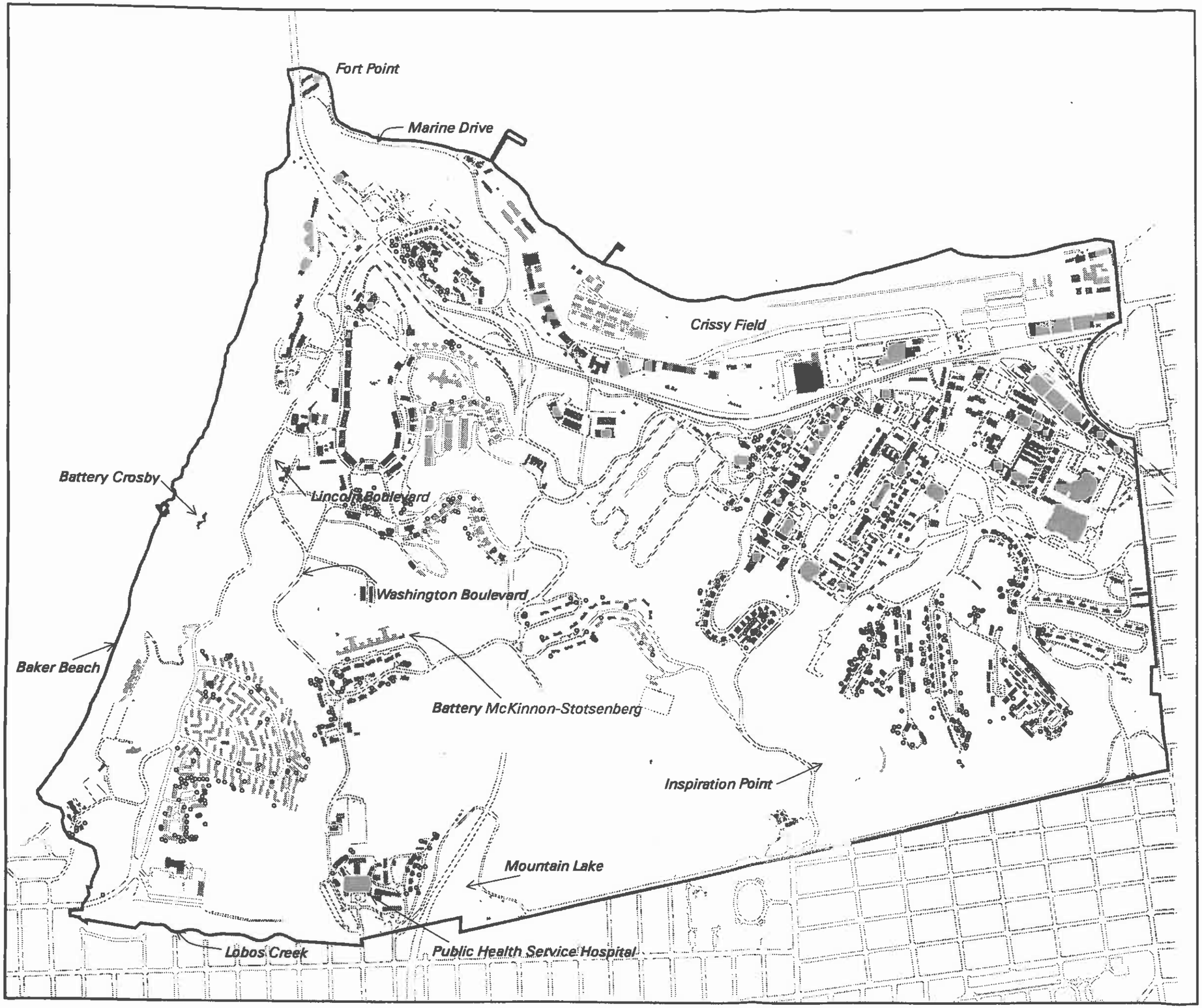
Monterey Cypress. This species most often exhibits branch breakage, particularly in areas where the trees are exposed to high winds or at the edge of roads and in open areas. The other common defect is codominant trunks, where bark inclusions create a weakness. Most inventoried Monterey cypress trees are larger than 36 inches in diameter, indicating they are in the final stage of useful landscaping life.

The Monterey cypress root system is generally unable to support trees taller than 50 feet. These trees lack tap roots for structural support and, when surface soils become saturated, they blow over easily (Smith, Stephen pers. comm.).

Monterey Pine. The Monterey pine is subject to several types of failure: poor limb development, root rot, and bole failure related to cankers caused by western gall rust. Thus, all parts of the tree are candidates for failure. Breakage of large branches is the most common type of failure, but root or bole failure is common. Many of these trees may be expected to live longer than the Monterey cypress.

Blue Gum Eucalyptus. Like Monterey cypress, eucalyptus grows so rapidly outside its native environment that its weight often exceeds its structural capacity (Shigo 1986). The eucalyptus currently has no debilitating pests except armillaria mellea, a root disease, and the impending longhorn eucalyptus borer. Branch failure of the eucalyptus is a constant hazard; branches are usually very high and heavy.

FIGURE 3-9. LOCATIONS OF HAZARDOUS TREES IN PARTIAL SURVEY



∘ Hazardous Tree Location

Source: Based on a partial survey by Britton Tree Services, Inc., 1994 and 1995.

Scale 1″ = 1000′

0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

15-Nov-95

phaztree-f.eml

Table 3-7. Relative Hazard of Landscaping Trees

Species	Proportion of Landscaping Trees (%)	Part of Tree Most Likely to Fail		
		Roots (%)	Bole (%)	Limbs (%)
Acacia	4	0	78	21
Cypress	32	6	70	24
Eucalyptus	30	5	6	89
Pine	18	42	33	25
Other	16	–	--	--

Notes: Data are based on unadjusted hazard rating of 200 or greater (Hermann Zillgens Associates 1988).

– = insufficient data available for evaluation.

Blackwood Acacia. This short-lived tree has very brittle branches that frequently break off. Most older trees have significant rot in the bole. Acacias must be pruned or replaced frequently because of their short life span.

Coast Live Oak. Most of the native oaks on the Presidio are very old and contain some heart rot but, where unirrigated, are not hazardous. Where irrigated, they tend to develop root or bole rot and become hazardous.

Fire Hazards

Because cool temperatures and moisture from fog drip reduce the impacts of summer drought at the Presidio, wildfire has had little effect on the structure or health of the Presidio forest. Although warm, dry summer weather conditions occasionally produce high fire hazard, such episodes are infrequent.

Fuels do develop by litter fall in the unmanaged eucalyptus stands, but periodic removal of fallen branches and mowing of understories in many stands have inhibited fuel accumulation.

At least three forest fires have occurred in recent years, but the acreages burned were small. The U.S. Army maintained a modern fire suppression capability on the base and pursued a policy of fire exclusion in the forest. Fuel treatment by prescribed fire has never been attempted.

WILDLIFE HABITATS

Information on wildlife occurrence at the Presidio presented here is condensed from Appendix L, "Wildlife Inventory", which is based on wildlife surveys conducted at the Presidio for this plan by Jones & Stokes Associates and its subconsultants: John Harris, Ph.D.; Elizabeth Pierson, Ph.D., and William Rainey, Ph.D.; and John Hafernik, Ph.D.

Because of its isolation, the Presidio is characterized by a low diversity of reptiles, amphibians, and mammals. Most vertebrates that have been recorded there are birds. Most of the Presidio's native habitats have been substantially altered by humans, including the extensive areas of habitat altered by the introduced forest. Nonetheless, the Presidio provides important remnant wildlife habitat within the developed environment of San Francisco, where habitats and wildlife are scarce. Of particular importance is the use of the Presidio forests by neotropical migrant birds. For these long-distance migrants, the Presidio is an island of suitable habitat bounded by water and urban development. Presidio forests also provide essential habitat for wintering birds and for locally declining species, including California quail, western screech owl, wrentit, and Hutton's vireo, that have been extirpated elsewhere in San Francisco. Thus, despite its isolation, the Presidio provides an important linkage to coastal forests to the north and south.

Special-Status Wildlife Occurrence

Special-status wildlife species that are present or could be present and have been surveyed for at the Presidio are described below.

Definition of Special-Status Wildlife Species

Vertebrate and invertebrate species federally listed or proposed for listing as threatened or endangered are protected under the federal ESA (50 CFR 17.11). In California, state-listed threatened or endangered species are protected under the California ESA (14 CCR 670.5).

In addition to listed and proposed species, special-status species include wildlife and invertebrates in the following categories:

- animals listed or proposed for listing as threatened or endangered under the federal Endangered Species Act (50 CFR 17.11 [listed animals] and various notices in the Federal Register [proposed species]);
- animals that are candidates for possible future listing as threatened or endangered under the federal Endangered Species Act (61 FR 40: 7596-7613, February 28, 1996);
- animal species of concern to the U.S. Fish and Wildlife Service;
- animals that meet the definitions of rare or endangered under CEQA (State CEQA Guidelines, Section 15380);
- animals listed or proposed for listing by the State of California as threatened or endangered under the California Endangered Species Act (14 CCR 670.5);
- animal species of special concern to the California Department of Fish and Game (Remsen 1978 [birds], Williams 1986 [mammals], and Jennings and Hayes 1994 [amphibians and reptiles]);
- animals fully protected in California (Cal. Fish and Game Code, Section 3511 [birds], 4700 [mammals], and 5050 [reptiles and amphibians]); and
- animals listed as sensitive by the local U.S. Forest Service region (Forest Service Manual 2670) or U.S. Bureau of Land Management resource area.

Actual and potential occurrence of special-status wildlife at the Presidio is summarized in Table L-2 of Appendix L, "Wildlife Inventory", along with each species' legal status, habitat requirements, and distribution in California.

Arthropods

Of the taxa targeted in the rare arthropod surveys, only the tree lupine moth was detected at the Presidio (Hafernik 1994). Surveys conducted by DeBenedictis (1988) and Hafernik (1994) indicated that this species is common at Lobos Creek and Mountain Lake and throughout the Presidio wherever its host plant *(Lupinus arboreus)* is present. Suitable habitat is generally lacking at the Presidio for other rare arthropods that were the subject of the surveys.

One of the three known host plants for the mission blue butterfly *(Lupinus variicolor)* is known to occur on coastal bluffs of the Presidio near the Golden Gate Bridge. Surveys of this area did not detect evidence of eggs, larvae, or larval feeding damage of mission blue butterflies, and it is unlikely that the Presidio was ever part of the historic range of this species based on its known distribution (Hafernik 1994).

Although the mydas fly has no special legal status, it is potentially rarer and more threatened than the federally listed mission blue butterfly, and the Presidio is the only place where the species has been observed recently (Hafernik 1994).

Reptiles and Amphibians

No special-status amphibian or reptile species were detected at the Presidio during the field surveys conducted for this report. Populations of California red-legged frogs, southwestern pond turtles, and legless lizards have already been extirpated from the Presidio. The presence of bullfrogs at Mountain Lake may be one reason why California red-legged frogs no longer reside there. The large number of introduced red-eared sliders at the lake may be a reason why southwestern pond turtles no longer occur there.

Birds

A total of 29 special-status bird taxa (i.e., species and subspecies) have been observed at the Presidio. Most of these species appear as rare or uncommon migrants or seasonal visitors, however, and only the relatively abundant raptors have been confirmed as breeding at the Presidio. Almost half of the documented special-status birds have been sighted as rare or uncommon migrants flying over the Presidio.

Foraging Hawks. Sharp-shinned hawks and Cooper's hawks are frequent migrants and winter visitors to the Presidio, but neither species breeds there. Both of these species of hawk forage throughout the mosaic of grasslands, shrublands, and forests of the Presidio. All forest types are used, but broken forests with adjacent grasslands or riparian habitats are preferred.

Breeding Hawks and Falcons. Three hawk nests are currently active at the Presidio: two red-shouldered hawk nests near the Golden Gate Bridge and on a hillside north of Lobos Creek in tall eucalyptus trees, and a red-tailed hawk nest in a tall Monterey pine near El Polin Spring. In

addition to active nest sites, territorial behavior by red-shouldered hawks was recently seen near Mountain Lake, near the central water-supply reservoir, and near the Officer Family Housing near Arguello Boulevard. Territorial red-tailed hawks were observed at the west side of the golf course. These observations may represent additional nesting pairs. American kestrels are also known to breed at the Presidio, and palms, snags, and buildings are potential nest sites (Fish and Hatch pers. comms.). No nests of this species, however, were specifically identified during the spring 1994 surveys of Presidio forests.

Screech Owls. A pair of western screech owls has been heard calling near Inspiration Point, one bird in a small redwood grove and the other downslope near El Polin Spring. Because the coastal race of this species is almost entirely resident, these screech owls may represent a mated pair, but only one recent record exists of this species from the Presidio or vicinity. (Stallcup pers. comm.) Screech owls prefer to nest and roost in oak woodlands, and restoration of coast live oaks at the Presidio would benefit this species. In addition to the Inspiration Point area, screech owls have also been detected at El Polin Spring, at Arguello Gate, and along Lobos Creek (Murphy pers. comm.).

Marine Birds. Many of the Presidio's special-status birds are largely confined to the ocean or bay. Common loons, brown pelicans, harlequin ducks, and marbled murrelets are rare or uncommon visitors to the Presidio coastline; American white pelicans have been noted flying over San Francisco Bay from the Presidio on several occasions. Ospreys, western snowy plovers, long-billed curlews, elegant terns, and California least terns are uncommon or rare visitors along the coastal shoreline and nearshore waters of the Presidio. Double-crested cormorants are common residents of the bay and ocean shorelines, and they also frequent Mountain Lake. Although they do not breed at the Presidio, double-crested cormorants nest on the Oakland Bay Bridge (Hatch pers. comm.).

Passerines. Only four special-status passerines have been recorded at the Presidio: loggerhead shrikes, willow flycatchers, yellow warblers, and possibly saltmarsh yellowthroats. Loggerhead shrikes are rare winter visitors to grassland and scrub habitats and have been observed on only a few occasions.

Willow flycatchers and yellow warblers are migratory visitors to willow riparian habitats along Lobos Creek and at Mountain Lake. Neither species nests at the Presidio because suitable nesting habitat is limited and because of the presence of brown-headed cowbirds. Both willow flycatchers and yellow warblers have been extirpated as nesting species in the lowlands of California as a result of nest parasitism by brown-headed cowbirds (Remsen 1978, Harris 1987, Sanders and Flett 1989).

Common yellowthroats are uncommon visitors to Mountain Lake, where they have been recorded in all seasons. They are suspected of nesting in emergent vegetation surrounding the lake. The saltmarsh yellowthroat is the most likely subspecies of common yellowthroat to be found on the San Francisco Peninsula (Grinnell and Miller 1944); however, the subspecific status of yellowthroats at Mountain Lake has not been determined.

Mammals

General. The salt marsh vagrant shrew is one of only two special-status mammals that have been recorded at the Presidio. This species is restricted to saltmarsh habitats in the southern and central San Francisco Bay region. This shrew is likely to have occurred at the Presidio in saltmarsh habitat located between Fort Point and Crissy Field. No suitable habitat for the species is currently found on the Presidio; thus, there is no reason to believe that it currently occurs there (Harris 1994).

Bats. The Yuma myotis was the only special-status bat detected during focused surveys conducted at the Presidio. This species is somewhat tolerant of human disturbance and is one of the few species of bats that persists in relatively urbanized areas.

Other special-status bats that could potentially occur at the Presidio include long-eared myotis, fringed myotis, long-legged myotis, Townsend's big-eared bat, and mastiff bat; all of these species are Category 2 candidates for federal listing as either threatened or endangered. Habitat conditions or available insect food (or both), however, do not appear suitable for any of these species, and their occurrence at the Presidio is unlikely.

General Wildlife Occurrence

Since the late 1800s, at least 262 vertebrate species have been recorded at the Presidio: 225 birds, eight amphibians, 15 reptiles, and 14 mammals.

Amphibians and Reptiles

Overall, the diversity of amphibians and reptiles at the Presidio is low. Species commonly observed are California slender salamanders, western fence lizards, and alligator lizards, found in coastal dune scrub and eucalyptus forest habitats of the Presidio. Introduced species, including red-eared sliders and bullfrogs, occur at Mountain Lake. Coast garter snakes inhabit Lobos Creek riparian habitat.

Surrounded by salt water and urbanization, the Presidio is an isolated island for amphibians and reptiles. In contrast to birds and mammals, amphibians and reptiles have poor dispersal capabilities and are unlikely to emigrate to such isolated areas. In addition, species with small, isolated populations are especially vulnerable to local extirpation. These factors probably hastened the demise of California red-legged frogs, western pond turtles, and other species of amphibians and reptiles that once lived at the Presidio. The Presidio's isolated conditions could promote the future extirpation of several relatively rare species that are now present.

Birds

More than 85% of all vertebrates that have been observed at the Presidio are birds. The vast majority of these, however, are spring and fall migrants or winter visitors and do not nest at the Presidio; 49 species have been confirmed as nesters. Birds breed throughout the Presidio because it is one of the only large areas of native and naturalized habitat on the northern San Francisco Peninsula. Surveys suggest that Lobos Creek, Mountain Lake, and forests near Inspiration Point are especially important habitat areas for a wide variety of riparian and forest birds.

Although most of its birds are migrants or nonbreeding visitors, the Presidio represents an important habitat area for these species. Aside from Golden Gate Park, the Presidio is the only large area of open space habitat that offers shelter, food, and water for migratory birds on the northern peninsula. As such, it provides an important link from forested lands of the southern peninsula to those of Marin County across the Golden Gate.

Several species occur at the Presidio that have been extirpated or are extremely rare elsewhere in San Francisco, including California quail, western screech owl, wrentit, and Hutton's vireo. Because of their declining local status and restricted distribution, these species could be considered species of local concern. In addition, conifer forests at the Presidio represent an important resource for various irruptive species (species that increase in numbers suddenly), including red-breasted nuthatch, red crossbill, and pine siskin, especially in years with prolific cone production.

Natural and excavated cavities in these forests harbor a variety of cavity-nesting species, such as American kestrel, acorn woodpecker, red-breasted sapsucker, Nuttall's woodpecker, downy woodpecker, hairy woodpecker, northern flicker, ash-throated flycatcher, tree swallow, and violet-green swallow. In general, cavities are most abundant in dead or decadent trees, and Presidio forests provide some of the most important habitats for dependent bird species remaining on the San Francisco Peninsula.

Other important native wildlife habitats include riparian forests near Mountain Lake and along Lobos Creek that support the most diverse bird populations at the Presidio. Because of their high insect productivity, these forests are especially attractive to breeding birds and to neotropical migrants en route to northern breeding grounds. Remnant oak forests are also extremely attractive to a diversity of breeding and migrant birds, including a variety of flycatchers, warblers, and vireos. Despite their introduced status, flowering eucalyptus attract many hummingbirds, warblers, and orioles. Along the coastline, the Presidio defines the northern breeding limits of at least one species, the hooded oriole, which nests in palm trees near Letterman Army Hospital.

One introduced bird species, the European starling, inhabits the Presidio's forests. The starling is present in most stand types and probably excludes native birds from their nesting cavities and roosting sites. Brown-headed cowbirds are native to North America but not to California; they were first reported in the state in the 1860s, and by 1930 they had expanded their range north as far as the Bay Area (Laymon 1987). In the following decades, nest parasitism by this species caused the extirpation of many lowland, passerine bird species. Nest parasitism by cowbirds continues to

threaten songbirds nesting at the Presidio; for example, Trail and Baptista (1993) found that 40-50% of the Nuttall's white-crowned sparrows in San Francisco are parasitized by cowbirds, threatening the long-term survival of this subspecies in the Bay Area.

Mammals

General. Fourteen species of native mammals occur or formerly occurred at the Presidio. Three species (the California ground squirrel, black-tailed deer, and salt marsh vagrant shrew) have been extirpated. Opossums, brush rabbits, and house mice likely occur at the Presidio but were not observed during recent surveys. Kurz (1983) reported Trowbridge shrews, long-tailed weasels, and gray foxes as occurring at the Presidio, but these records were not supported by specific descriptions or dates and their validity is uncertain.

In general, the Presidio is characterized by a low diversity of small mammals. The most common species are California voles, western harvest mice, roof rats, vagrant shrews, and ornate shrews. Valley pocket gophers are abundant throughout the Presidio. Broad-footed moles probably occur along Lobos Creek and near Inspiration Point. Striped skunks and raccoons are widespread, perhaps because they are extremely tolerant of human activity.

Three introduced species of mammals occupy the Presidio: feral cats, roof rats, and fox squirrels (Harris 1994). Cats are abundant throughout the Presidio and have been seen in all habitat types. Some feral cats are probably reproducing at the Presidio.

Roof rats occur near El Polin Spring and are probably also associated with buildings at the Presidio (Harris 1994). Fox squirrels are rare and have been observed by Golden Gate NRA personnel at Inspiration Point on only a few occasions. The lack of squirrels at the Presidio is curious because both fox squirrels and eastern gray squirrels are present at nearby Golden Gate Park and the trees along Park Presidio appear to provide an adequate travel corridor for tree squirrels.

Bats. Based on the results of acoustic surveys conducted at the Presidio, Pierson and Rainey (1995) concluded that Mexican free-tailed bats, red bats, hoary bats, California myotis, and Yuma myotis probably forage at the Presidio. By far the most abundant species, accounting for 70-90% of identified acoustic events in all habitats and seasons, is the Mexican free-tailed bat. The next most common species at the Presidio (present only during fall, winter, and spring only) is the hoary bat; all other species are rare.

The primary foraging area for bats at the Presidio, especially for Mexican free-tailed bats, is Mountain Lake. The next most important habitat, and the one with the greatest bat species diversity, is forest edges at the interface between uneven-aged forest stands and open areas. Limited acoustic activity was detected in open grasslands, on coastal dunes, and in riparian habitat along Lobos Creek.

Wildlife Habitat Values of the Presidio Forest

Figure 3-10 illustrates the relative wildlife habitat values of each forest stand at the Presidio. This rating is based on a numerical system reflecting both valuable habitat characteristics and observed diversity of bird use in different forest types (Appendix L).

High-Value Habitat at the Presidio

The tree species providing the most valuable habitat based on observed bird diversity are the native coast live oak and willows. Next in value is eucalyptus, followed by Monterey pine, Monterey cypress, and other species. In terms of habitat characteristics, large blocks of forest habitat with multistoried vegetation and an herbaceous or shrub understory are considered to have the highest value. Stands that are near water, provide nesting or other critical habitat elements for special-status wildlife, or are continuous with other large stands are also considered valuable.

The forest stands that are ranked as having the highest overall wildlife habitat value are the oak and willow forests at Mountain Lake and along Lobos Creek. Several large blocks of high-value habitat also occur in the central and southern portions of the Presidio, principally in eucalyptus stands.

Observed Wildlife Use of Forest Types

Most common resident mammals, reptiles, and amphibians apparently do not distinguish among different forest types at the Presidio. Their occurrence is most closely related to the condition of the understory, where they live. In contrast, many species of birds exhibit preferences for certain forest types or conditions, even during migration. For example, snags (especially large trees with cavities) are used extensively by woodpeckers and other cavity-nesting birds.

Eucalyptus. Despite their introduced status, naturalized eucalyptus groves offer high-value wildlife habitat. Flowering eucalyptus and the insects attracted to them draw large numbers of migratory birds, including Anna's hummingbirds, Allen's hummingbirds, red-breasted sapsuckers, ruby-crowned kinglets, golden-crowned kinglets, American robins, cedar waxwings, yellow-rumped warblers, western tanagers, black-headed grosbeaks, and northern orioles. The sturdy branches of eucalyptus provide suitable nesting sites for red-shouldered hawks, red-tailed hawks, and other raptors. Cavities excavated in eucalyptus offer habitat for various woodpeckers and other cavity-nesting species.

Monterey Pine and Monterey Cypress. Monterey pine and Monterey cypress offer less habitat value than eucalyptus, and the habitat value of the two species is nearly identical. These introduced conifers attract chestnut-backed chickadees, pygmy nuthatches, and American robins. They also provide roosting sites for larger species, such as pigeons, doves, owls, crows, and ravens. Similar to eucalyptus, pine and cypress offer sturdy nesting sites for raptors. Irruptive species such

as red-breasted nuthatch, red crossbill, pine siskin, and a diversity of woodpeckers are attracted to these coniferous forests at the Presidio.

Redwood. The only significant stand of redwoods at the Presidio is near Inspiration Point. It has high wildlife value because it is surrounded by other large forest stands. The redwood stands support most of the same species that are found in pine and cypress stands. As noted previously, the large stand of redwoods may support a pair of western screech owls (Stallcup pers. comm.).

Coast Live Oak. Despite its relatively small acreage at the Presidio, coast live oak woodland receives heavy use by migratory and nesting birds. These native trees host a variety of insects that attract insectivorous birds. Species such as solitary vireos, Hutton's vireos, black-throated gray warblers, lazuli buntings, rufous-sided towhees, California towhees, and chipping sparrows are often associated with live oaks at the Presidio.

Riparian Communities. Riparian willows and other trees associated with Mountain Lake and Lobos Creek are perhaps the most important nesting and migratory bird habitats at the Presidio. The combination of dense, multistoried vegetation in association with water provides essential habitat for many species, such as flycatchers, vireos, warblers, grosbeaks, and sparrows. The fencing and thick vegetative cover near Lobos Creek make many areas nearly inaccessible to humans, and wildlife there are rarely disturbed. Similarly, much of the shoreline of Mountain Lake is inaccessible except by boat and provides secluded resting areas for wildlife.

Ornamental Plantings. Ornamental plantings usually have relatively low wildlife value. They are usually near buildings, roads, and other developed areas where wildlife is disturbed frequently. On the other hand, many ornamental species produce fruits and berries that attract large numbers of scrub jays, northern mockingbirds, cedar waxwings, American robins, and European starlings. Flowering ornamental shrubs attract Anna's hummingbirds, Allen's hummingbirds, and possibly rufous hummingbirds. Palms near Letterman Army Hospital provide nesting habitat for American kestrels and hooded orioles (Fish and Hatch pers. comms.).

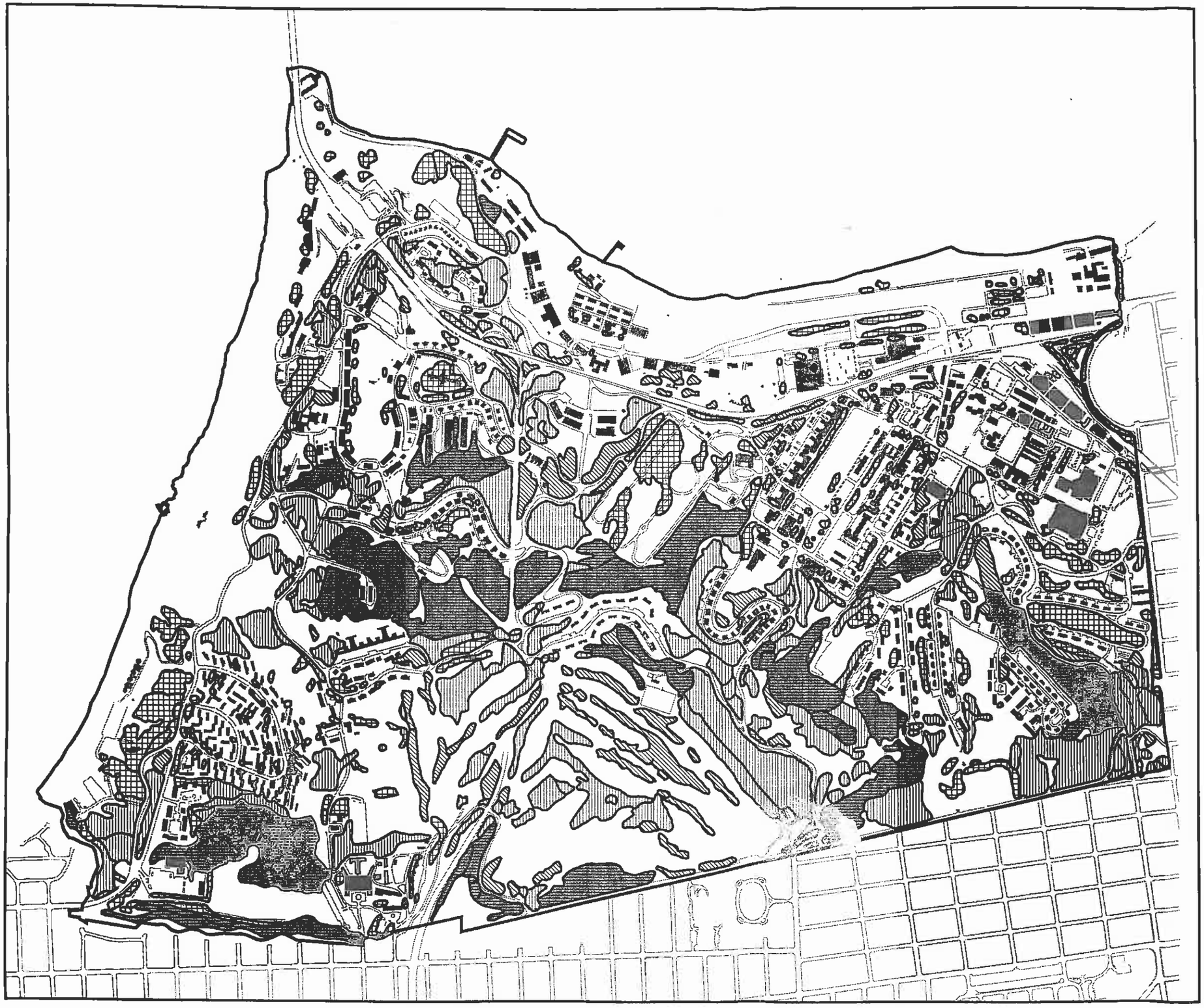
Regional Wildlife Habitat Considerations

At the tip of the San Francisco Peninsula, the Presidio lies in a region inhabited by vertebrate species typical of the southern and inner portions of the Coast Ranges (Hooper 1944, Grinnell and Miller 1944, Ingles 1965, Hall 1981, Stebbins 1985). The Presidio could be a northern range limit for several vertebrate species or subspecies because their range limits coincide with some portion of the system formed by the San Francisco Bay and the Sacramento-San Joaquin River Delta (Hooper 1944, Hall 1981, Stebbins 1985).

Conclusions

For native wildlife species, many existing habitats at the Presidio are isolated, fragmentary, disturbed, and dominated by non-native plant species. Despite all of these factors that reduce the

FIGURE 3-10. WILDLIFE HABITAT VALUES OF FOREST STANDS



WILDLIFE HABITAT VALUES

High Value – tree species with high wildlife diversity; large, multistoried stands with herbaceous or shrub understory; large stands contiguous with those stands; stands near water; special-status wildlife species habitat.

Moderate Value – tree species with moderate wildlife diversity; intermediate-sized or elongated, same-aged stands with limited understory.

Low Value – tree species with low wildlife diversity; small, isolated same-aged stands, usually managed as landscaping.

Not rated

Source: Appendix L

Scale 1" = 1000'

0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

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pwildrats-f.aml

quality of Presidio wildlife habitats, some forest stands have relatively high value. Because of habitat scarcity in urbanized San Francisco, all habitats at the Presidio are relatively valuable.

Native habitats and introduced forests of the Presidio are regionally important to nesting olive-sided flycatchers and other neotropical migrants (including most flycatchers, vireos, warblers, tanagers, and grosbeaks), locally declining species (California quail, western screech owls, wrentits, and Hutton's vireos), and at least one species at the northern limit of its breeding range (hooded oriole). For these reasons, the Presidio is a link of vital importance to resident and migratory birds in a severely threatened, but poorly understood, portion of the Pacific Flyway.

RECREATIONAL RESOURCES

Small playgrounds, tennis courts, and athletic fields are located throughout the housing areas of the Presidio. Julius Kahn Playground, along the southern edge of the Presidio, provides additional facilities under management of the City and County of San Francisco. The park is readily accessible to local neighborhoods south of the Presidio, and, like the adjacent city-managed Mountain Lake Park, it is used extensively by San Franciscans (American Society of Landscape Architects 1986).

The Presidio Golf Course provides 18-hole golfing in a well-maintained, forested setting. The use of planted stands to delimit the course is described in Chapter 2. The golf course is within the watershed of Mountain Lake. The golf course, formerly operated jointly by the U.S. Army and the private Presidio Golf Club, is now operated by an NPS concessionaire. Accordingly, forest vegetation at the golf course has been maintained independently of general Presidio forest maintenance. Nonetheless, management of golf course forest stands is included in this forest plan.

In addition to developed recreation facilities, the Presidio offers excellent opportunities for walking and hiking. Popular areas are Baker Beach, the ocean bluffs, the Golden Gate Promenade, and the forest. In addition to trails along the coastal bluffs and through bayside areas, trails also have been developed in forested portions of the Presidio, bringing users into portions of the forest not accessible by roadway. These walkways are used for walking, bicycling, jogging, and exercising pets.

VISUAL RESOURCES

The Presidio is a major visual resource of the San Francisco Bay Area. Together with Golden Gate Park to the south, it brings to San Francisco a designed, forested landscape that appears to be natural in many areas.

The visual resources of the Presidio can be considered from five perspectives: regional vantage points, major highways passing through the post, adjoining neighborhoods, vista points, and other interior viewpoints. All of these visual elements of the Presidio were recently evaluated in detail by the American Society of Landscape Architects (1986).

Regional Landmark

From a regional perspective, the Presidio is seen as a large tract of dark green, wooded hills that separate the whitewashed city from the graceful, orange-colored spans of the Golden Gate Bridge and the blue of the Pacific Ocean. Although developed for military activities, the Presidio is also perceived as a forested garden atop ocean bluffs and bayside uplands standing in marked contrast to the surrounding urban landscapes.

As a regional landmark, the Presidio can be seen readily from the Golden Gate Bridge, the Marin Headlands, several Marin County bayside communities, the north waterfront of San Francisco, high-rise buildings in the financial district, and hill summits in the city such as Twin Peaks. In most of these views, the Presidio appears as a densely forested series of low ridges. Individual stands, for the most part, cannot be differentiated in these views. Only large-scale forest removal operations would be noticed from these perspectives.

Highway Views

U.S. Highway 101 and State Route 1 pass through the Presidio and join near the approach to the Golden Gate Bridge. Forest stands are seen in the foreground and middleground from these routes, obscuring some of the historic views of the bay waterfront.

Various stands screen Presidio developments from view. Because the roadways are elevated in some areas and at ground level in others, the screening function varies between canopy and understory vegetation. Stand treatments along the roadways may not be noticed by rapidly passing highway travelers, but they could eliminate the existing visual screening of post facilities or enhance the visibility of historic structures.

Neighborhood Views

The Presidio is bordered on the east and south by residential neighborhoods. Thus, forest vegetation along these perimeters is plainly visible from these public use areas.

Several multistory residences along or near the southern border afford expansive views of the Presidio forest and the bay, Golden Gate Bridge, and ocean beyond. To preserve these views from encroaching Presidio tree growth, several residents have periodically topped certain stands near Julius Kahn Playground. This activity has been most persistent eastward from the park to the Walnut Street area. For the most part, these actions were approved of by the Army's base commander, but no plan to coordinate this forest management practice was ever formulated. The

Army discontinued approval of tree topping for private view preservation on December 17, 1990 (Swift pers. comm.).

The prevalent topping height east of the park is uniformly about 30-35 feet. West of the park topping has been less persistent and uniform, but topping heights of 50-60 feet appear more common. These stands are part of the original introduced forest and now show low vigor.

Although trees can often respond to topping by growing laterally and eventually upward again, topping increases stress on the growing individuals, creates a structural weakness, and provides an opening for the entry of disease or insects. Nonetheless, major losses of the trees being topped have apparently not occurred.

Because this area is plainly visible to visitors who use the park, as well as to adjoining residents, significant public attention would focus on any forest management activities in this area.

Presidio Vista Points

The Presidio forest is constantly visible from public use areas within the post. Most stands are visible from along the many roadways and walkways throughout the park. Interior portions of the extensive windbreak stands along the central ridgelands are only visible to forest explorers.

Three vista points were designated by the U.S. Army along the interior roadways of the Presidio. Paved turnouts are provided at these vistas: at Inspiration Point, along Washington Boulevard on the western slope of Rob Hill, and on Lincoln Boulevard overlooking Crissy Field. Although the original forest was designed to maintain scenic vistas from these locations (see Chapter 2, "Natural Resource History"), naturalized forest stands have encroached noticeably on the views from Inspiration Point and Rob Hill over the years.

Forest management activities immediately adjacent to these vista points would be quite visible, as would treatments to more distant stands west, north, and east of Inspiration Point.

SOIL EROSION

Wind, rain, sandy soil textures, recreational use, and hydrophobicity in forest stands combine to create conditions conducive to severe soil erosion at the Presidio.

Inventory of Soil Erosion

A survey of eroded sites at the Presidio was conducted in 1993-1994. Table K-1 in Appendix K, "Soil Erosion Site Inventory", lists the characteristics of 53 eroded sites and an accompanying map of site locations. For each numbered erosion site, the table lists the type of erosion, the soil-geologic-vegetation unit (from Figure 3-1b) where it is occurring, the existing soil type, a rating of the status and severity of the erosion, the causes of the erosion, planned future vegetation and forest stand management, and recommended erosion control actions.

General Locations

Soil erosion at the Presidio extends over two general areas. One of these is the southeastern quarter of the Presidio, starting near the Presidio Boulevard entrance, continuing around Julius Kahn Playground, past Inspiration Point, and into the center of the Presidio northeast of Washington Boulevard. The second area begins near the Public Health Service Hospital and extends westward to the slopes inland of Baker Beach, then northward to the sea cliffs west of Lincoln Boulevard.

Two smaller areas within these general locations have the most severely eroded sites. One is the land surrounding Julius Kahn Playground; the other is the slope above Baker Beach. A third site of serious concern is near the southwestern corner of the National Cemetery.

Types of Erosion

Erosion types are sheet, rill, and gully. On the Presidio, the dominant type of erosion is gully erosion; of the 53 erosion sites, 39 exhibit some form of gully erosion. Rill erosion is not a significant problem at the Presidio.

Sheet erosion is occurring on some areas of sandy soil in conjunction with gully erosion. "Sand creep" or sand displacement better describes the phenomenon: a slow downslope movement of sand particles in response to footsteps. This is a significant type of erosion at 10 sites.

The result of gullying and sand creep is root exposure, which is a significant concern at 22 sites. Other types of erosion are cut banks (five sites), landslides (three sites), piping (one site), and wind erosion (one site). The fact that wind is identified as a significant type of erosion on only one site (foredunes on Baker Beach) is testimony to the efficacy of the introduced forest as a windbreak.

Correlation of Erosion to Soil-Geologic-Vegetation Units

Of the 53 erosion sites, 28 occur in soil-geologic-vegetation unit 221, dune sand-Sirdrak series soils where the vegetation is nearly all historic forest (Figure 3-1b). Ten erosion sites occur in unit 311, Colma Formation-old dune sand/alluvium-Pachic Haplustoll/Typic Ustropept soils,

where, again, the vegetation is mostly historic forest. Fourteen erosion sites occur on various bedrock types of the Franciscan Formation; six are on serpentinite-Henneke (variant) series soils; and five are on soft sandstone/shale–Cronkhite series soils.

Degree of Erosion

Of the 53 erosion sites, 49 are actively eroding. Two sites show signs of inactive or presently stabilized erosion, one has low activity, and one has been repaired.

Active erosion sites have been rated (minor, moderate, or severe) for degree of erosion and impact on the environment. A minor rating applies if the present erosion site is a small area, is developing slowly, and has little present impact and low likelihood of future impact on the environment. A moderate rating means that the existing erosion site is of moderate size, has a moderate rate of development, and does not now have a significant impact on the environment but may result in a significant impact if not controlled. A severe rating indicates that the erosion site is having a significant effect on the environment that limits future land use or requires use of special management techniques to avoid limitation.

Of the 49 active erosion sites, nine are rated as minor, 22 as moderate, and 18 as severe. Of the 18 severe erosion sites, 75% (13) are on dune sand and Sirdrak series soils.

Dominant Causes of Erosion

The dominant cause of erosion at the Presidio is foot traffic, implicated as the cause in more than half of all erosion sites (29 of 53). The Presidio is crisscrossed by unplanned and unmaintained foot trails through the historic forest and areas of natural vegetation, many of which are used extensively. Gullies carrying concentrated runoff have developed where foot trails cross steep slopes, ascend or descend at a steep slope, or cross soil that is loose and unstable.

Several trees have been killed by foot trail–induced root exposure, and many others are threatened. Displacement of sand by foot traffic in the sandy Sirdrak series soils may cause severe root exposure with or without concentrated runoff. Soil compaction by foot traffic also increases runoff rates.

Concentration of runoff on the landscape is an important, if not the main, contributing factor in erosion on 29 sites, with foot traffic frequently implicated as the cause. Drainage from roads and other constructed facilities is a main or contributing factor to erosion at 14 sites. Other causes of erosion are road cuts (four sites); natural cliff-face erosion (two sites); and wave action, streamflow, and cut and fill (one site each).

As described at the beginning of this chapter under "Environmental Conditions", soil hydrophobicity, which may be a result of planting the forest on dune sand soils, is a significant

contributing factor to reduced rainfall infiltration and increased runoff rates. This condition is a contributing factor to erosion on 15 sites.

Severely Eroding Sites

As discussed above, 13 of the 18 erosion sites rated as severe occur on dune sand and Sirdrak series soils. These sites are described in detail in Appendix K, "Soil Erosion Site Inventory". They occur in five areas:

- the area around Julius Kahn Playground,
- areas near Baker Beach,
- a site near the National Cemetery,
- soils extending from Mountain Lake to Fort Scott, and
- the Pacific coastline.

Chapter 4. Values, Management Issues, and Recommended Management Goals

FOREST VALUES

The Presidio forest has three primary types of values: historic values; inhabitation, open space, and visual values; and natural resource values. The historic Presidio forest is a major contributing element to the National Historic Landmark status, having been established by the military occupants nearly 100 years ago. One of the purposes of afforestation was to provide shelter from the wind that sweeps the northern tip of the San Francisco Peninsula. The shelter continues to function today, making the Presidio more inhabitable for NPS's intended uses.

The Presidio forest also provides an island of open space and natural habitats in an intensively urbanized landscape. In contrast to the busy city, the Presidio forest affords quiet refuge and an opportunity to view and encounter the landscapes of forest and seacoast. The Presidio's open space provides habitat for wildlife and rare plant species, in addition to recreation opportunities. In terms of bird habitat, it represents a key link between wildlands of California's central and northern coasts.

NATURAL RESOURCE MANAGEMENT ISSUES AND CONCERNS

Over the past decade, the U.S. Army has commissioned two forest planning efforts, which raised management issues and solicited the public's concerns. During the Golden Gate NRA's planning process for the Presidio lands, additional issues emerged as comments on the draft GMPA and accompanying EIS. Issues and concerns from both of these processes can be summarized as follows:

- Should the cultural landscape be restored, particularly historic vistas, by removing naturalized, unplanned forest stands? Should restoration be complete or partial?
- How should the widespread decadence of the historic forest be dealt with?
- Can the landscape be restored without compromising windbreak function or endangering retained forest trees?
- Should eucalyptus be removed from the Presidio forest to reduce fire hazard?

- How can areas where forest is removed be restored to native habitats?
- How can rare plant habitats be preserved and enhanced?
- What are the Presidio's wildlife values and how can they be protected or enhanced?
- Can species diversity be increased at the Presidio through nonintensive forest management of certain areas or establishment of understory in the historic forest?
- How can forest edges and landscaping trees and shrubs be managed to provide suitable, safe environments for planned park uses?
- How can tree and stand cutting be carried out to minimize disruption to park visitors?
- How can pedestrian traffic and park drainage facilities be managed to arrest soil erosion?
- Can the topping of trees by park neighbors be prevented?

NATURAL RESOURCE MANAGEMENT DIRECTION OF THE GENERAL MANAGEMENT PLAN AMENDMENT

A major objective of the GMPA for the Presidio is to "restore and rehabilitate the historic planted forest to its originally designed boundaries and reestablish areas of native vegetation and wildlife habitat" (Golden Gate National Recreation Area 1994a, 1994b). The GMPA also establishes that "Native plant communities and sensitive wildlife habitat will be protected during the course of the forest's rehabilitation. Some areas of nonhistoric forest will be removed to restore historic vistas; the sites will be planted with appropriate species to restore native communities. . . ." The GMPA also calls for native plant restoration and significant reforestation in areas from which existing development will be removed.

With regard to the Presidio Forest Management Area delineated in the GMPA, which is only a portion of the Presidio forests, the GMPA calls for clearing nonhistoric forests and replanting them with native vegetation "to enhance natural resource values and restore important vistas". It further states that "parts of the forest that provide important wildlife habitat will be maintained".

Several actions of forest removal are cited thereafter. The largest of these is planned for Inspiration Point, where vistas will be cleared and non-native plants removed. Another is removal of trees that have become established outside the historic forest above the coastal bluffs and restoration of native vegetation, specifically at Rob Hill. Several other removals to restore historic vistas or internal visual corridors are mentioned, including at Infantry Terrace, several areas within Fort Scott, and the Cavalry Stables area.

In addition to these removal actions, the GMPA refers to particular trail relocations to reduce erosion within the forest. The GMPA does not address visual screening afforded by the Presidio's forest that accommodates planned developed uses. It also does not address the practice of tree topping the Presidio's forest, as practiced by neighbors for view restoration, and it does not address fire hazards presented by the forest.

NATURAL RESOURCE MANAGEMENT GOALS

Organization of Natural Resource Management Policy

Vegetation management options can be articulated in three steps. Natural resource management goals set forth the overall direction and purpose of natural resource management. The goals recommended below can form the underlying basis of a natural resource plan.

Natural resource management options recommended in Chapter 5, "Forest Management Options", set forth specific decision criteria for management actions to achieve these goals, including management concepts unique to each area of the Presidio.

Natural resource management treatments and practices described in Chapter 6, "Vegetation Management Treatments and Practices", provide practical techniques for implementing the management options.

Goals

The following natural resource management goals were formulated in response to the previously identified management issues and public concerns, and in conjunction with direction provided by the GMPA.

Restore and Maintain the Historic Forest

Identify and Restore Historic Forest Extent. As opportunities arise, gradually restore the Presidio forest to its extent circa 1935, especially historic vistas, except where forest removal would reduce the extent of high-value wildlife habitat without expanding rare plant habitat or higher value habitat, or would eliminate needed screening for planned land uses.

Preserve and Regenerate Historic Forest Stands. Preserve historic stands as long as possible. When an appropriate threshold of stand viability is exceeded, cut and replant trees using original species whherever feasible.

Maintain Windbreak Functions and Prevent Forest Windthrow. During regeneration of the historic forest after episodes of damage or loss, limit the size of cutting openings and orient them to minimize windthrow potential and the temporary loss of windbreak function.

Prevent Hazardous Accumulations of Fuel. Where the need arises, regenerate eucalyptus stands where they existed in the historic forest, but continue to reduce fuel accumulations periodically if they become hazardous to adjacent property.

Restore and Maintain Native Plant Communities

Restore Native Plant Communities where Nonhistoric Forest Is Removed. Restore probable prehistorical vegetation as determined from historic documents and soil-geology inferences. Integrate forest stand removal and native plant restoration after episodes of stand loss to minimize periods of exposure of unvegetated soils. Use best and most recent techniques to prepare, plant, and maintain restoration sites.

Preserve and Enhance Rare Plant Species Habitats. Evaluate habitat needs of rare plant species occurring at the Presidio and prioritize actions required to preserve and enhance those habitats. Control invasive non-native vegetation as needed.

Protect and Enhance Wildlife Values

Protect Wildlife Values. Avoid adverse impacts on critical habitats of rare and endangered species known to occur at the Presidio. Avoid adverse impacts on nesting habitat of raptors and other special-status species. Retain nonhistoric forest stands if they have high general wildlife value, unless they can be replaced with higher value wildlife habitat or expanded habitat for rare native plants. Wherever possible, avoid adverse impacts of natural resource management activities on wildlife during the breeding season (March 15-July 15).

Increase Native Species and Habitat Diversity. Designate certain areas of the forest for increasing naturalization to promote diversity of habitats and species. Where the approach is not in conflict with historic forest restoration, increase the number of trees and shrubs that are species native to the Presidio. Maintain areas with existing understory and high structural diversity where high wildlife value exists, if this approach is not in conflict with other objectives.

Maintain Landscaping Needed for Planned Park Uses

Maintain Visual and Acoustical Screening between Incompatible Land Uses. As needed, maintain and enhance forest and landscaping screens bordering the highways that traverse the Presidio or separate park or highway maintenance areas from public activity areas.

Reduce Hazards Posed by Landscape Tree Decadence. Rate the relative hazard of all landscaping trees (including those at edges of forest stands) that could pose a danger to people, buildings, or vehicles. Base these ratings on both degree of exposure of targets and tree defect, according to the NPS Western Region system. Treat hazardous trees by pruning, cabling, or removal in order of priority, based on the relative ratings, as soon as funding allows. Replace removed trees that are part of the historic landscape with the same species wherever feasible.

Provide Needed Open Space

Provide Pleasing Backdrops for Park Activities. Limit forest regeneration activities to natural openings or areas of tree damage to minimize disruption of open space values during gradual regeneration of the historic forest.

Control Drainage and Pedestrian Traffic to Arrest Soil Erosion. Take actions to terminate uncontrolled foot access throughout the forest by establishing a network of well-marked, designated paths. Eliminate discharges of concentrated runoff onto unprotected soils to reduce soil erosion.

Restore Historic Vistas. When restoring the historic forest, give priority to restoration of historic vistas.

Maintain Nonhistoric Forest Stands Bordering the Golf Course. Maintain and regenerate stands that border the golf course in response to natural events, but minimize use of chemical fertilizers and pest control and encourage increased structural and species diversity within stands. Retain some dead and decadent trees that do not pose hazards to golfers to provide potential habitat for nesting birds and roosting bats.

Manage the Forest Opportunistically and Adaptively to Ensure Economic Feasibility and Public Acceptance

Manage Stands Primarily in Response to Natural Events. Implement the above natural resource management goals incrementally in response to natural losses from wind, insect infestation, fire, or other natural or uncontrolled events. Amend treatment practices continously based on experience gained at the Presidio and in Golden Gate Park.

Avoid Future Topping of Trees by Neighboring Residents. Eliminate future requests for topping of Monterey cypress trees by West Pacific Avenue neighbors by regenerating, extending stands with closely related, lower growing cypress species that retain the historic character of the stand.

Publicize Important Stand-Cutting Activities. Establish a program of public notification for planned tree-cutting operations following natural losses, targeted to both neighbors and general park visitors.

Chapter 5. Forest Management Options

INTRODUCTION

General land management intentions for various areas of the Presidio have been established by the GMPA. These plans, as well as the environmental conditions, habitat condition, and history of each stand, dictate its proper management. This chapter outlines forest management options that could achieve the natural resource management goals stated in Chapter 4. These management options have two components. First, management options that could apply throughout the Presidio forest are described. Second, suggested management options specific to each of 28 special management areas are presented. Where special-area options would be incompatible with Presidio-wide options, special-area options should prevail (although, in most cases, the Presidio-wide and special-area options are compatible).

Opportunities for management activity will gradually result in the treatment of increasing forest areas and forest stands according to certain management options (described in detail in Chapter 6, "Vegetation Management Treatments and Practices"). These management options are categorized as follows:

I. removing nonhistoric forest and restoring native vegetation and rare plant habitat;

II. reestablishing the historic forest in undeveloped areas where it is no longer present;

III. preserving and regenerating the historic forest through intensive maintenance;

IV. allowing naturalization of the historic forest through nonintensive maintenance enhancing natural resource values and protecting or enhancing existing wildlife value;

V. maintaining landscaping trees, heritage trees, and historic vistas through intensive maintenance, including hazard tree treatment; and

V(s). maintaining tree/shrub screens through intensive maintenance, including hazard tree treatment.

Chapter 6 also includes forestwide practices for various elements of forest management that apply under several or all of the options:

- stand cutting,
- planting and reforestation,
- planting maintenance,
- erosion control,
- fire protection,
- woody debris disposal, and
- cultural resource protection.

PRESIDIO-WIDE MANAGEMENT OPTIONS

Historic Forest Preservation

Area-specific vegetation management decisions should be based on vegetation management decision matrices, such as those illustrated in Figure 5-1, as well as on direction specified in the GMPA for each management area of the Presidio. Matrices should reflect the general intent of restoring the historic forest but should modify the restoration in response to the other management goals (Chapter 4). Such decision matrices could be used on an ongoing basis in conjunction with onsite observation and resource data in Chapters 2 and 3 to make vegetation management decisions.

Four decision matrices make up the set:

- forest removal matrix for present forest stands not a part of the historic forest,
- vegetation replacement matrix for forest stands to be removed,
- forest reestablishment matrix for historic forest stands no longer present, and
- forest regeneration matrix for extant historic forest stands.

As opportunities arise, intensive vegetation management would be required to regenerate and restore the historic forest. Historic species and relative abundance would generally be used in such instances. Some historic forest stands would be maintained nonintensively, however, and opportunities to improve wildlife habitat would increase. In these areas, historic species would be maintained, but relative abundance might change. Introduction of coast live oak and other native species into areas managed for low maintenance is appropriate under this option.

Use of the decision matrices and special management area direction described in this chapter would result in the management pattern shown in Figure 5-2. Figure 5-3 and Table 5-1 illustrate an estimate of how the goals and options in Chapter 4 might affect stand management. Actual management, however, should reflect changes made after project site surveys and in collaboration with the park's historical landscape architect.

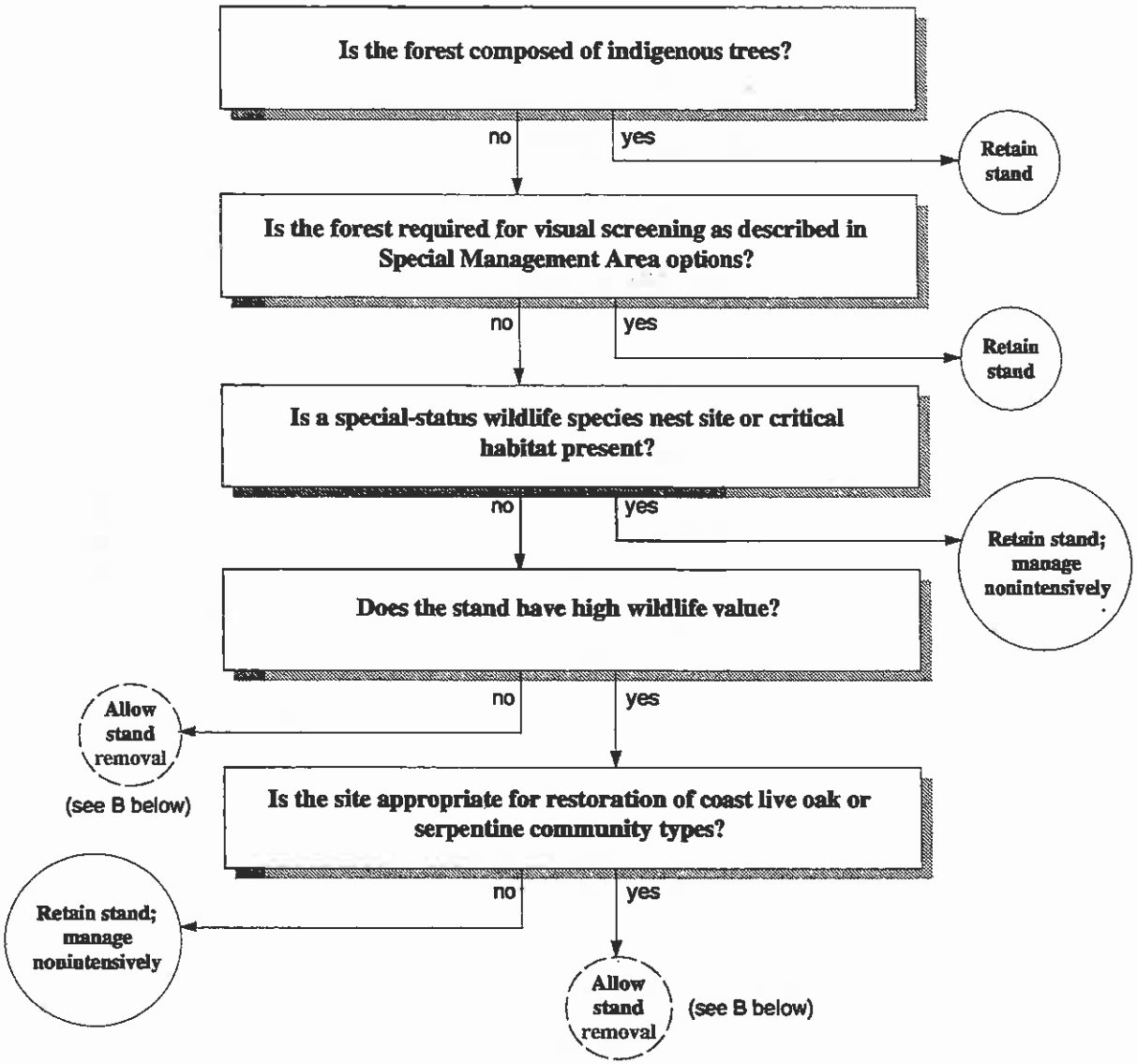
The management treatments and practices needed to pursue each vegetation management option are described in Chapter 6.

Figure 5-1. Vegetation Management Decision Matrixes

A.

Vegetation Removal Decision Matrix

for present stands not a part of the historic forest



B.

Vegetation Replacement Decision Matrix

for present stands to be removed (from A above)

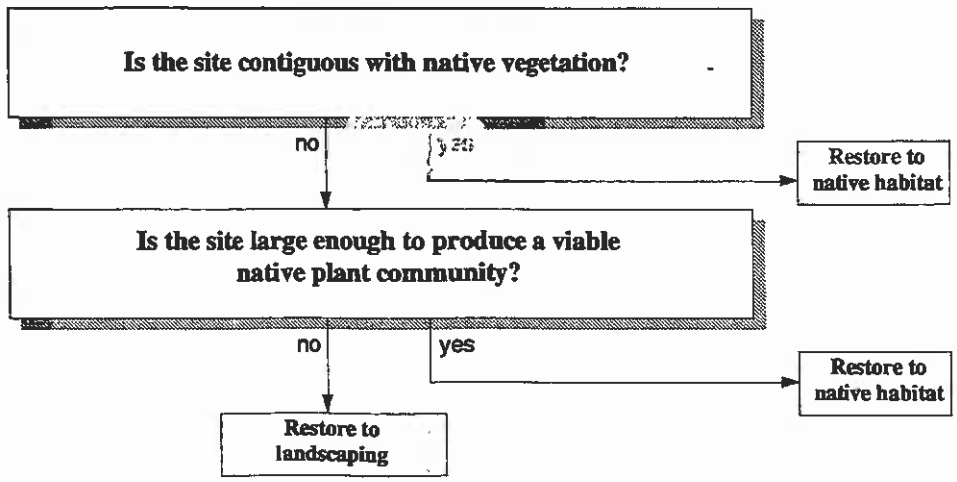
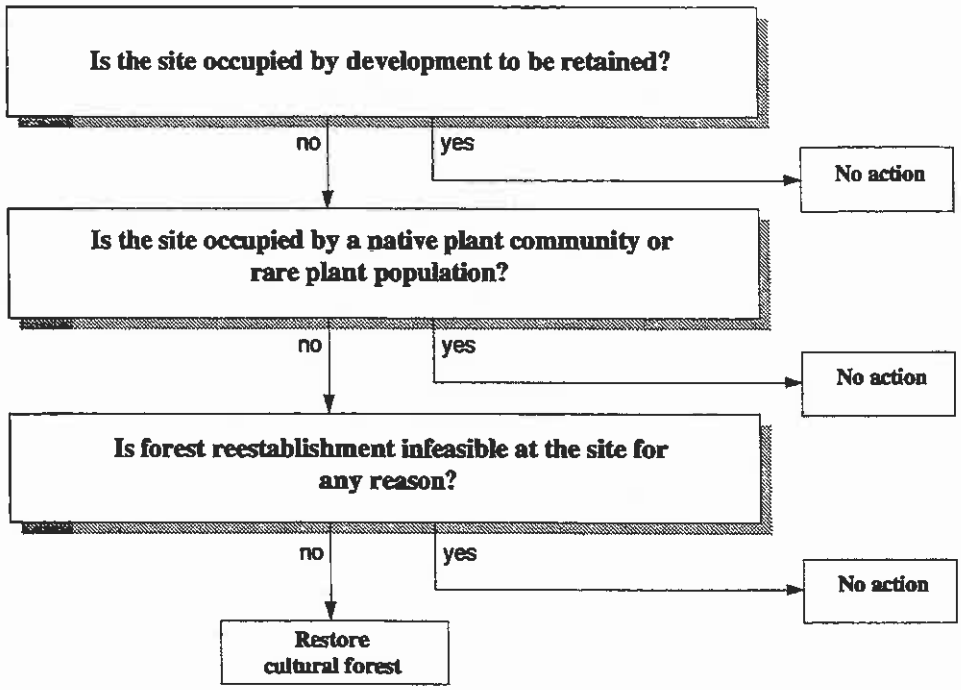


Figure 5-1. Continued

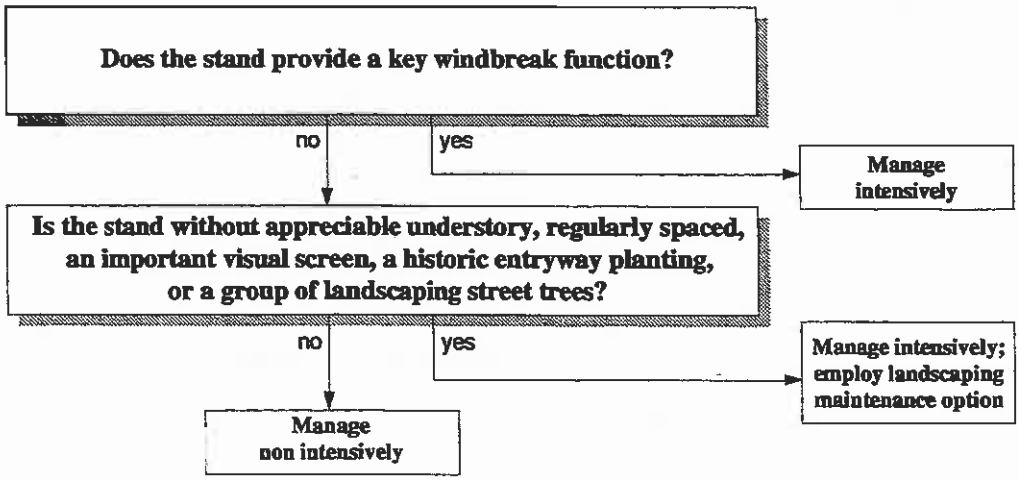
C.

Vegetation Reestablishment Decision Matrix
for historic forest stands no longer present



D.

Vegetation Regeneration Decision Matrix
for extant historic forest stands



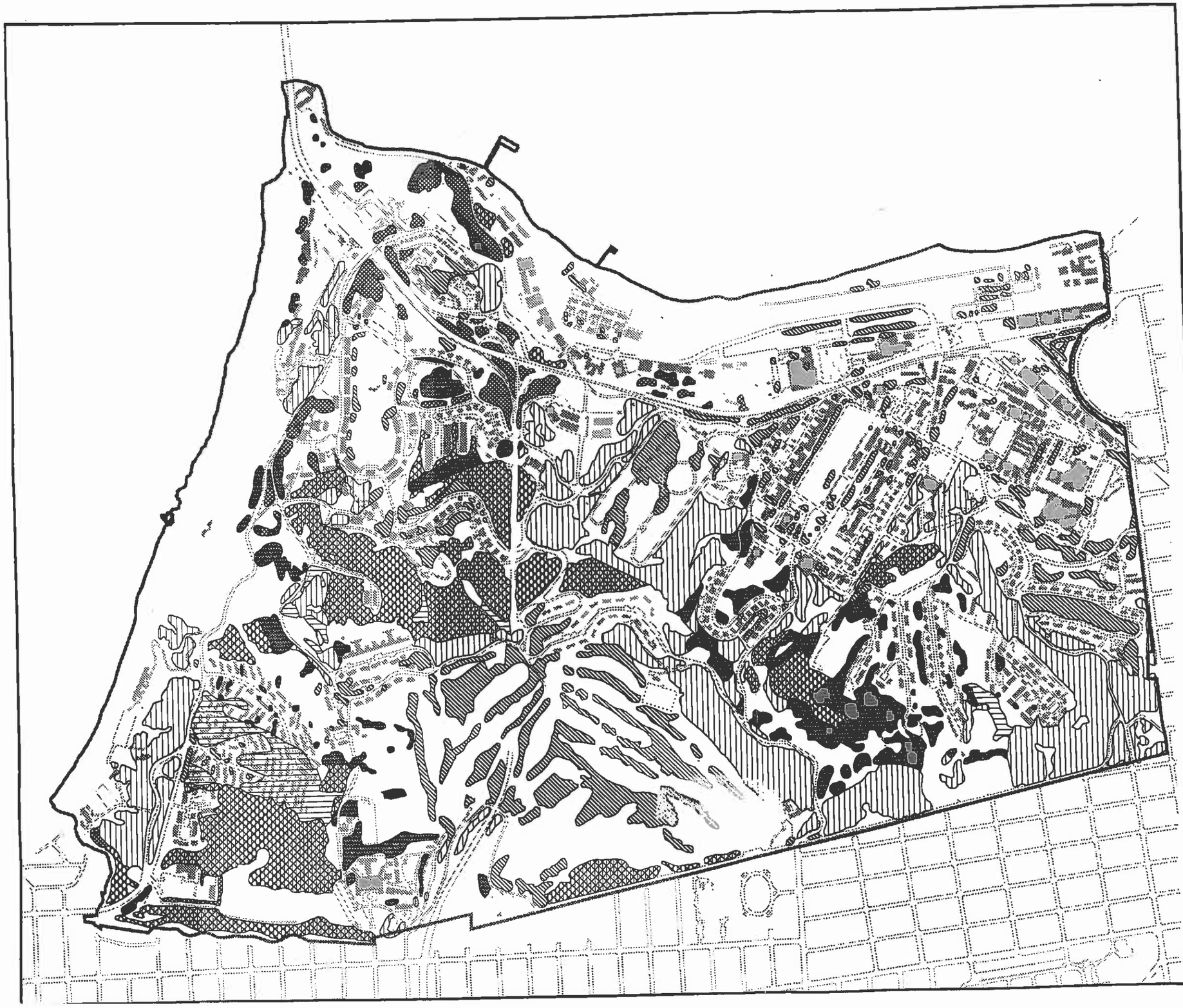


FIGURE 5-2. A VEGETATION MANAGEMENT OPTION

GENERAL PRESCRIPTION

- I. Remove Nonhistoric Forest and Establish Native Vegetation
- II. Reestablish Historic Forest
- III. Preserve and Regenerate Historic Forests Through Intensive Management
- IV. Maintain Historic Forest Through Nonintensive Management and Facilitated Naturalization
- V. Maintain General Landscaping, Heritage Trees, and Historic Vistas
- V(s). Maintain Landscaping for Visual Screening

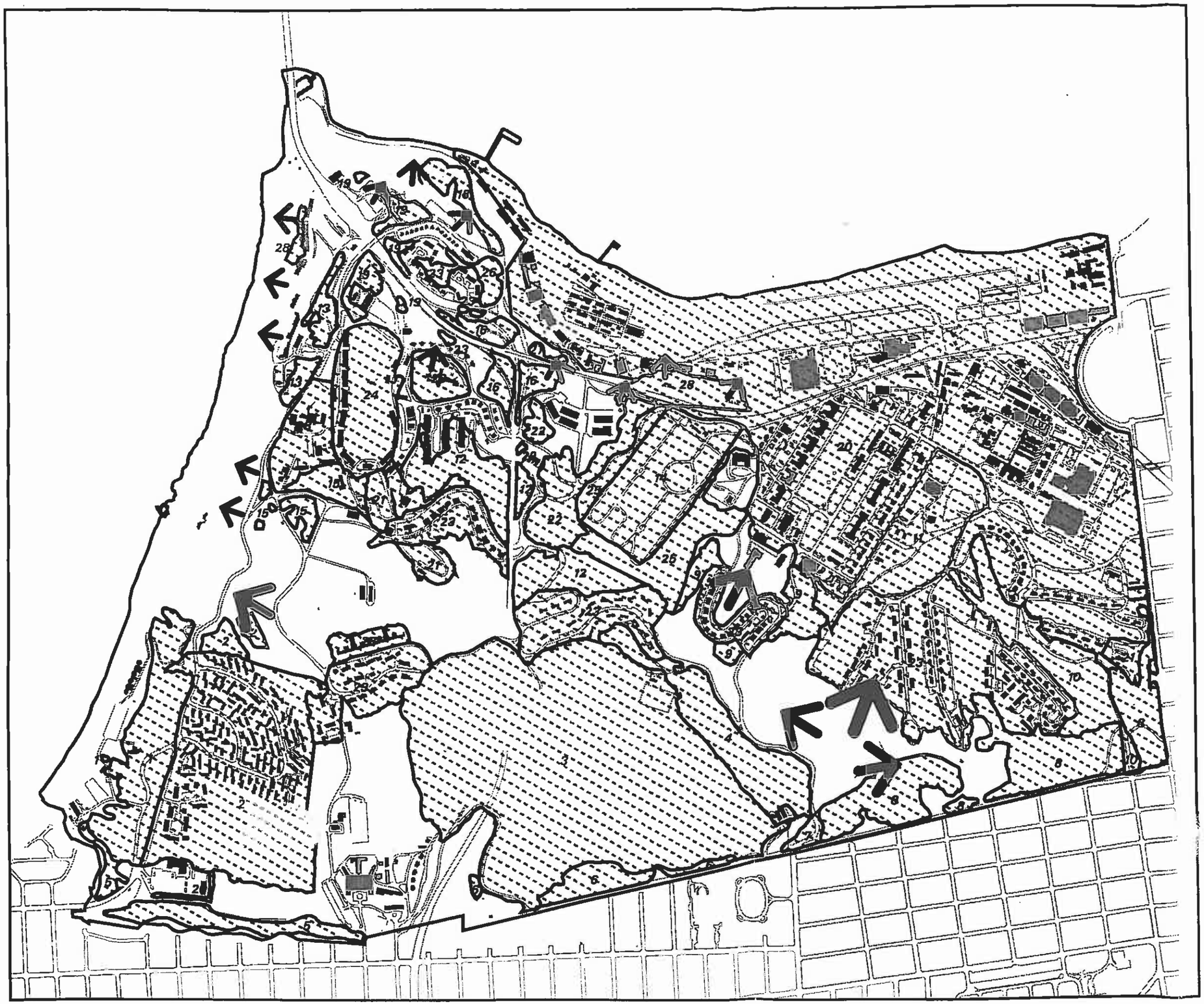
NOTE: Stand data is contained in Appendix D.

Scale 1" = 1000'

0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

FIGURE 5-3. SPECIAL MANAGEMENT AREAS AND HISTORIC VIEW RESTORATION OPTIONS



12 Special Management Areas

Historic View Restoration Options

Scale 1" = 1000'

0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

15-Nov-95

punits-f.aml

Table 5-1. Recommended Allocations of Stand Types to Management Options
(acres)

Stand Species	Management Option[a]						Species Total
	I	II	III	IV	V	V(s)	
Acacia	4.5	0.2	5.3	0.1	2.7	1.3	14.1
Cypress	9.8	4.0	78.5	10.1	49.6	6.9	158.9
Cypress/pine	5.2	16.8	11.6	27.5	1.9	1.5	64.5
Cypress/pine/eucalyptus	0.0	0.0	0.7	0.0	0.0	0.0	0.7
Eucalyptus	15.1	1.3	50.0	60.9	17.1	10.3	154.7
Pine	24.8	0.0	9.7	4.9	11.7	0.9	52.0
Redwood	0.5	0.0	0.5	1.7	0.3	0.0	3.0
Other	2.1	0.0	2.2	7.5	19.5	0.2	31.5
Total	62.0	22.3	158.5	112.7	102.8	21.1	479.4

[a] Management option codes:

I - Remove nonhistoric forest and establish native vegetation.

II - Reestablish historic forest.

III - Preserve and regenerate historic forest through intensive management.

IV - Maintain historic forest through nonintensive management and facilitated naturalization.

V - Maintain general landscaping, heritage trees, and historic vistas.

V(s) - Maintain landscaping for visual screening.

Note: Total acreage is larger than total acreage of existing forest stands because it includes acreage of forest to be reestablished (i.e., option II).

Native Vegetation Restoration

Forest stands removed would be replaced with the following native vegetation communities:

- dune scrub,
- serpentine grassland,
- serpentine chaparral,
- coastal prairie,
- coastal scrub,
- live oak woodland, and
- live oak riparian forest.

Descriptions of these communities as they presently occur at the Presidio are provided in Chapter 3. The determination of which native plant community to restore at each site will be based on the historic vegetation of the site (Figure 2-1), which was identified by the analysis of geology and soils (see Chapter 2), and on site-specific topographic, soil, and vegetation conditions.

Native vegetation restoration concepts are described in Appendix H, "Concepts for Restoration of Native Habitats at Forest Removal Sites on the Presidio of San Francisco". Key features of that restoration plan are:

- using locally native plant material only,
- salvaging native plants from forest understory before removal,
- establishing a native plant nursery for propagating and storing restoration material,
- removing duff and debris accumulated under forests,
- treating soils for hydrophobicity and acidity,
- controlling erosion,
- controlling aggressive weeds,
- removing slash and debris resulting from forest cutting operations, and
- cutting sprouts or applying herbicides to sprouting stumps.

Restoration approaches for each of the major restoration sites shown in Figure 5-2 are also described in Appendix H.

Scenic Vista Restoration

In the original afforestation of the Presidio, summit vista points were left covered by the native, low-growing coastal prairie, coastal scrub, and coast live oak woodland or mixed evergreen forest communities (Chapter 2). This scheme was intended to afford an uninterrupted view of the bay and ocean from these summits, even when the forest matured.

Since the early 1930s, trees have either been planted or naturally expanded upslope into these designed open spaces. Views of the bay and ocean are now appreciably blocked. Conversion to the original vegetation at the vista points would restore both expansive views and the native plant communities.

A significant policy of the GMPA is to restore historic vistas at Inspiration Point and Rob Hill by eliminating naturalized, expanded stands and restoring native vegetation communities. Refer to Appendix H for guidelines on how to restore these particular vistas and native plant communities.

Treatment of Hazard Trees

Hazard trees at the Presidio should continue to be identified and treated. These include landscaping trees and trees at the edges of forest stands in high-use areas. In general, the hazard tree program applies to individual trees and small groups of trees, not to forest stands. Treatment should be prioritized, based on the hazard tree rating system, until all trees considered potentially hazardous (rated 4 or higher) have been treated. Identification and treatment will probably be permanent programs, however, because trees tend to become hazardous as they age. A hazard tree management plan is described in Appendix B.

Treatment of Erosion Sites

Nonnatural eroding sites of special concern described in Appendix K, "Soil Erosion Site Inventory", should be treated as soon as possible. The network of informal footpaths throughout the Presidio forests and native plant communities should be converted to designated, marked trails, and the abandoned trails should be obliterated. Other nonnatural eroding sites listed in Table K-1 should be monitored and treated if erosion accelerates or if unique resources are threatened.

SPECIAL MANAGEMENT AREA OPTIONS

The distribution of special management areas across the Presidio is shown in Figure 5-3. These areas, and management options for them, have been developed to accommodate special aspects of historic forest restoration or to meet other management goals that vary from place to place at the Presidio. These options are consistent with resource management policy established in the GMPA. The purpose of delineating each area is reflected in the management area "goal". Implementation of many of these options will require collaboration between the Presidio forester and historical landscape architect to moderate transitions from forest stands to developed areas.

Special Management Area 1: Baker Beach

Location. The area contains the historic windbreak stands west of Lincoln Boulevard and south of Battery Crosby.

Management Area Goals. Maintain present tree cover to provide uninterrupted windbreak and erosion control.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Maintain the historic forest using intensive management techniques, pursuing a continuous forest canopy.
- Preserve seaward views from coastal batteries according to battery treatment guidelines described for Special Management Area 28.

Special Management Area 2: Enlisted Family Housing

Location. The area includes the Wherry Housing enlisted family housing group, a cypress stand to the north, and a large cypress-pine stand to the south.

Management Area Goals. Reestablish the historic forest boundaries and enhance open space qualities of the area after removal of the 91 nonhistoric buildings.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Maintain landscaping trees while housing remains; remove landscaping trees if the buildings are demolished.
- Regenerate the remnant of historic forest in the southern portion of the management area by allowing naturalization of the residual forest to naturally expand its extent to its historic boundaries using low-maintenance management techniques. Allow openings of as much as 0.5 acre to develop (not patterned after historic forest openings) and eventually constitute as much as 25% of stand acreage to enhance wildlife values.
- Restore native vegetation and historic forest to areas presently occupied by development in the northern portion of the special management area if demolition occurs.

Special Management Area 3: Presidio Golf Course

Location. The Presidio Golf Course includes all forest stands bordering fairways and driving ranges, which are nonhistoric forest stands.

Management Area Goals. Manage forests to define the golf course and to maintain visual, windbreak, and ball screening functions, using low-impact landscape management.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Use minimal amounts of water, herbicides, pesticides, and fertilizers.
- Maintain golf course forest stands to provide visual containment and a windbreak, prevent damage to neighboring properties from errant golf balls, and minimize litterfall on fairways where possible. Fill in major canopy gaps along stand edges.
- Permit the presence of downed, woody material and encourage natural regeneration of trees and shrubs within stands to enhance wildlife habitat values.
- Increase the number of coast live oak and taller tree species native to San Mateo and Marin Counties.
- Retain large snags for cavity-nesting birds and roosting bats in the interior of the golf course stands if golfers would not be endangered by the collapse of such snags.

Special Management Area 4: Arguello Ridge

Location. The area contains the historic forest between the Presidio Golf Course and Arguello Boulevard.

Management Area Goals. Maintain the planted historic forest as long as possible and replicate it thereafter.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Maintain the current stands through sanitation cutting as long as possible until a specific threshold of stand loss is exceeded, then regenerate using intensive management.
- Regenerate the stands in rows using the same species and spacing.
- Successfully regenerate the eucalyptus stand before regenerating the cypress stand.

Special Management Area 5: Lobos Creek

Location. The Lobos Creek drainage south of Howard Road encompasses this area.

Management Area Goals. Protect and restore riparian habitat and associated high wildlife habitat values, and continue to screen riparian habitat from adjacent maintenance areas.

Management Area Guidelines. Consistent with the proposed Lobos Creek restoration plan, the following guidelines should guide all treatment actions:

- Protect and enhance natural regeneration of native oak and willow stands.
- Maintain viability of native vegetation by controlling invasive non-native vegetation, eliminating non-native trees, and maintaining suitable hydrologic conditions.
- Maintain or restore a stable stream channel consistent with concurrent NPS plans for Lobos Creek corridor restoration and water supply facility relocation.
- Maintain historic forest trees near the water treatment plant using intensive management techniques, and maintain a continuous forest cover to enhance visual screening.
- Because of high wildlife habitat values, restrict public access to the riparian corridor and locate public trails outside the most valuable habitat areas.

Special Management Area 6: Mountain Lake Drainage

Location. The Mountain Lake drainage borders the southern edge of the Presidio Golf Course along West Pacific Avenue.

Management Area Goals. Maintain golf course edges and screening, enhance wildlife habitat, and protect and enhance the riparian zone draining into Mountain Lake.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Using nonintensive management, allow for naturalization of stands with extant historic forest species and enhance natural regeneration of native vegetation.
- Control or eliminate invasive non-native vegetation.
- Eliminate planted forest trees from the lake's shoreline and replace with native riparian forest.

- Maintain and restore native riparian streambank cover and a stable stream channel.

- Maintain the northern perimeter of the stand to provide screening and a windbreak, prevent damage to neighboring properties from errant golf balls, and minimize litterfall on fairways where possible. Fill in major canopy gaps along stand edges.

Special Management Area 7: Arguello Boulevard Entrance

Location. Landscaping trees and shrubs along the Arguello Boulevard entrance constitute this management area.

Management Area Goals. Preserve and restore the dark and somber entrance described by General Hughes.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Maintain the eucalyptus stands that border the Presidio entrance as long as possible by applying sanitation cutting and hazard tree treatments as warranted.

- Remove individual dead or dying trees and shrubs and replant with the same species.

- Replace landscape trees that have died as documentation permits.

Special Management Area 8: Pacific Heights

Location. This area at the southeastern corner of the Presidio is bounded by Inspiration Point, El Polin Spring, and housing units to the north; Presidio Boulevard on the east; and the Arguello Boulevard entrance plantings to the west.

Management Area Goals. Preserve and regenerate the historic forest while eliminating tree topping by neighbors.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Preserve the historic forest as long as possible through sanitation cutting and regenerate using intensive management.

- In the area west of Julius Kahn Playground, regenerate using the previous option only in areas east of Quarry Road; replace the interior portions of stands north and east of Quarry Road with coast live oak woodland.

- In the area east of Julius Kahn Playground between Locust and Walnut Streets, replace the hedge-topped Monterey cypress plantation of approximately 250 trees with related cypress species such as *Cupressus goveniana* (Gowan) or *C. sergenti* (Sergent) that attain a maximum height of approximately 30 feet.

Special Management Area 9: Infantry Terrace Officers' Housing

Location. The area includes the forest and landscaping that encircles the Infantry Terrace Officers' Housing.

Management Area Goals. Maintain all windbreak stands while restoring historic vistas, eliminating safety hazards, and enhancing screening functions.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Clear nonhistoric forest to restore the historic vista between Infantry Terrace and the Main Post.

- Treat decadent trees that pose a hazard to life or property according to a hazard tree management plan.

- Maintain and regenerate the historic forest using intensive management.

Special Management Area 10: Presidio Boulevard Plantation

Location. The general perimeter of this management area is defined by Lovers Lane, Liggett Avenue, and Presidio Boulevard.

Management Area Goals. Maintain the planted historic forest as long as possible, and replicate it when maintenance is no longer possible.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Maintain the current stands through sanitation cutting until a specific threshold of stand loss is exceeded, and then regenerate using intensive management.

- Replant or replace the stands in precise rows using the same species.

Special Management Area 11: Tennessee Hollow

Location. Tennessee Hollow includes the former drainage presently occupied by enlisted family housing near MacArthur Avenue.

Management Area Goals. Restore the native riparian forest and historic forest.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Remove nonhistoric forest stands along the drainages and restore native riparian forest communities.
- Reestablish surface flows in the three surviving natural drainages.
- Preserve and regenerate the historic forest using intensive management.
- Remove asphalt and road base from within the driplines of retained trees.

Special Management Area 12: Park Boulevard and Kobbe Avenue

Location. This management area extends east and west of Park Boulevard and north of Kobbe Avenue and is part of an extensive forested area in the center of the Presidio.

Management Area Goals. Sustain historic stands while limiting maintenance costs and increasing wildlife value; restore native riparian forest in nonhistoric forested areas.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Encourage natural regeneration of the extant historic forest by using nonintensive management techniques.
- Restore the riparian forest corridor in the western portion now occupied by nonhistoric eucalyptus stands (as shown in Figure 5-2).

pecial Management Area 13: Lincoln Boulevard

Location. The area includes the cypress stands west of Lincoln Boulevard near Fort Scott.

Management Area Goals. Preserve the coastal windbreak function and historic forest character.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Maintain the historic cypress stands using intensive management; during regeneration, replace stands to replicate historic forest species and row pattern.

- Before beginning regeneration, remove dead trees, shrubs, and volunteer tree seedlings and saplings and restore grass groundcover.

Special Management Area 14: San Francisco National Cemetery

Location. The area includes the cemetery itself, which is maintained by the U.S. Department of Veterans Affairs.

Management Area Goals. Cooperate with the U.S. Department of Veterans Affairs to protect and preserve the National Cemetery.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Treat hazard trees adjacent to the cemetery that may cause damage to cemetery elements or the cemetery landscaping, according to a hazard tree management plan.

- Provide professional support to U.S. Department of Veterans Affairs staff for cemetery tree maintenance.

Special Management Area 15: World War II Memorial

Location. This area contains the forest stands surrounding the World War II Memorial and adjacent fuel storage tank.

Management Area Goals. Protect the World War II Memorial and the fuel storage tank from tree damage. Maintain the historic forest stands for windbreak function to visually screen the memorial from exterior intrusions.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Retain all trees and shrubs at the World War II Memorial as long as possible. As needed, replant with identical species and patterns.

- Maintain the forest stands east of Washington Boulevard using intensive management. Remove weedy vegetation and volunteer seedlings and saplings.

- Preserve and expand the serpentine habitat near the memorial. Remove escape trees and prevent the encroachment of trees.

Special Management Area 16: U.S. Highway 101/State Route 1 Interchange

Location. The area includes the remnant of historic forest and landscape trees surrounding the intersection of U.S. Highway 101 and State Route 1.

Management Area Goals. Screen buildings and adjacent areas from the highways, and retain historic forest values where screening is not compromised.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Retain dense, multistoried canopy using intensive management to maintain continuous screening of the highways from the stables and residences nearby.

- Regenerate stands as they age with identical species.

- Treat all hazard trees that may pose a danger to roads or structures according to a hazard tree management plan.

Special Management Area 17: Wool Court Landscape Trees

Location. The area consists of landscaping and street trees surrounding the former Fort Scott officers' club.

Management Area Goals. Restore the gardens and landscaping to their original, formal appearance.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Maintain the surrounding historic trees in accordance with the landscaping tree management option.

- Restore the gardens and landscaping according to historic descriptions and accounts of the officers' club, replacing senescent trees with the same species and in the historic locations consistent with other historic landscape guidelines.

- Continue to pollard sycamores.

Special Management Area 18: Fort Point Entrance

Location. The area includes stands between Battery East and Long Avenue.

Management Area Goals. Restore the historic forest, including seaward views from the battery, nonforest serpentine habitat, and the historic stands along Andrews Road.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Remove the nonhistoric forest and invasive vegetation along Battery East and between the battery and Lincoln Boulevard.
- Retain the historic forest row trees along Andrews Road using intensive management. Replant when necessary using the same species in rows, similar to the present pattern.
- Retain the historic apple and pepper trees within the stand that surround the former DeRussy House.
- Remove volunteer trees along Long Avenue and Lincoln Boulevard to restore the historic stand to its original extent.

Special Management Area 19: Toll Plaza

Location. The management area includes isolated trees and stands near the Golden Gate Bridge toll plaza and maintenance yard.

Management Area Goals. Provide visual screening of the highway, toll plaza, bridge maintenance area, and visitor structures and enhance vistas from the viewing area.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Treat hazard trees that pose a danger to life or property as described in a hazard tree management plan.
- Maintain visual screening of the highway, structures, and maintenance yard in accordance with the landscaping screening treatment while replacing decadent screening trees with Monterey cypress.

- Research the historic conditions of the site to design plantings consistent with the historic character.

Special Management Area 20: Main Post, Crissy Field, Residences

Location. This is the largest special management area, and it encompasses much of the most developed portions of the Presidio, principally in the northeastern portion (the Main Post, the Letterman Complex, the officer family housing south of Lombard Street, and Crissy Field). The area's vegetation is almost all landscaping.

Management Area Goals. Maintain landscaping and heritage trees.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Treat hazard trees that pose a danger to life or property according to a hazard tree management plan.
- Maintain landscaping and individual heritage trees.
- Modify general management as needed to accommodate plans adopted for Crissy Field habitat restoration.

Special Management Area 21: Generals' Quarters

Location. The area includes generals' housing at Muir Loop, Wright Loop, and Todd Street.

Management Area Goals. Maintain and enhance landscaping.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Treat hazard trees that pose a danger to life or property according to a hazard tree management plan.
- Maintain landscaping and individual heritage trees.

Special Management Area 22: Cavalry Stables

Location. This management area includes areas upslope of the Cavalry Stables and adjacent to the religious activities center.

Management Area Goals. Maintain the historic forest, protect historic vistas, preserve remnant natural dune scrub and riparian areas, and protect historic structures.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Employ intensive management to preserve and regenerate the historic forest.
- Remove non-native vegetation from the stands.
- Treat hazard trees that pose a danger to life or historic structures according to a hazard tree management plan.
- Maintain the historic forest that connects the former barracks and the Cavalry Stables.

Special Management Area 23: Housing Areas

Location. This management area includes the East, Compton Road, Hitchcock Street, and Infantry Terrace housing areas.

Management Area Goals. Maintain landscaping and visual screening values and eliminate safety hazards. Restore the native riparian corridor from El Polin Spring.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Employ landscaping treatment to preserve screening of housing from view from other areas.
- Treat hazard trees that pose a danger to life or property according to a hazard tree management plan.
- In the East Housing area, restore the native riparian forest along El Polin Spring and the natural drainages leading into Tennessee Hollow after the removal of 20 nonhistoric buildings. (See also Special Management Area 11, Tennessee Hollow.)

Special Management Area 24: Fort Scott

Location. The Fort Scott area includes all landscape trees surrounding the parade ground and barracks of Fort Scott.

Management Area Goals. Maintain the landscape trees to enhance the visual appearance of the area for future uses.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Maintain the trees in accordance with the landscape maintenance option.
- Treat hazard trees that pose a danger to life or property according to a hazard tree management plan.

Special Management Area 25: Cemetery Fringe

Location. The stands in this area border and extend south of the National Cemetery and are part of an extensive forested area near the center of the Presidio.

Management Area Goals. Sustain historic rows of trees framing the cemetery, prevent damage to the cemetery, minimize leaf fall onto the cemetery, and encourage naturalization of more distant areas to enhance wildlife value.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Along the cemetery borders, employ intensive management to maintain a continuous forest cover that provides a continual, even framing of the cemetery.
- Develop a gradation in tree height, with increasing height away from the cemetery, and consider coppicing the eucalyptus nearest the cemetery where large trees stand behind them. Reduce the height of trees framing the cemetery to prevent debris from damaging the cemetery and to minimize litter fall.
- Treat hazard trees on a high-priority basis.
- In areas beyond the cemetery vicinity, employ nonintensive management to increase wildlife value.
- Eliminate severe gully erosion southwest of the cemetery (see Appendix K, "Soil Erosion Site Inventory").

Special Management Area 26: Crissy Field Flight Path

Location. The area is located west of Crissy Field.

Management Area Goals. Restore the original Crissy Field flight path by reducing the eucalyptus stand to the historic forest extent, and restore native plant communities on the serpentine outcrop.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Remove the expanded portion of the naturalized stand and manage the remnant intensively.
- Replace cut forest with native plant communities.

Special Management Area 27: Crissy Field Avenue

Location. This area encompasses the Monterey pine and Monterey cypress stand above Crissy Field Avenue.

Management Area Goals. Restore the views and native vegetation in this area.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Maintain the existing trees using sanitation cutting.
- Gradually change to nonintensive management. Introduce coast live oaks into the stand.

Special Management Area 28: Batteries

Location. The batteries in this management area are McKinnon-Stotsenberg, Howe-Wagner, Godfrey, Boutelle, Marcus Miller, Cranston, Lancaster, East, Dynamite, Safford, Sherwood, and Blaney.

Management Area Goals. Preserve historic coastal battery structures and restore seaward views.

Management Area Guidelines. The following guidelines should guide all treatment actions:

- Remove nonhistoric trees and shrubs from the structures.
- Remove nonhistoric trees that obscure seaward vistas from the structures. Further study may be required to determine historic vistas from each battery.

- Replace removed trees with native plant communities or landscaping shrubs and groundcover to prevent erosion.

- Preserve and regenerate historic forest stands with intensive management.

Chapter 6. Vegetation Management Treatments and Practices

INTRODUCTION

This chapter describes various vegetation management treatments and practices needed to carry out the forest management options described in Chapter 5. Treatments and practices are vegetation manipulation and resource protection measures and encompass:

- forest removal,
- protection and management of native vegetation,
- forest maintenance and regeneration:
  - intensive management and replacement of continuous forest cover,
  - nonintensive management, and replace of naturalizing forest,
- tree removal treatments,
- landscaping maintenance and hazard tree management,
- planting and reforestation,
- vegetation maintenance,
- erosion control,
- fire protection,
- woody debris disposal, and
- cultural resource protection.

This chapter is supplemented by Appendix M, "Forest Management Activity Calendar and Equipment".

Vegetation management action should be preceded by preparation of annual action plans. These action plans, in brief, should indicate how the following treatments will be implemented at each work site. On-the-ground situations warranting deviation from prescribed actions should be noted and reasons recorded. These annual plans should always be based on remapping of treatment-area stands to ensure appropriateness of treatment and provide an accurate record for later reference. These annual records will provide a valuable legacy to forest managers in future decades.

FOREST REMOVAL

Purpose

Forest removal involves removing non-native, nonhistoric forest stands following stand damage and replacing them with native vegetation communities or, in a few cases, landscaping.

Before consideration of the following information, special management area options should be reviewed to verify that stands proposed for removal are intended not to be retained for visual screening or other purposes.

Protecting Wildlife and Wildlife Habitat Value

According to NPS policies, forest removal activities should not be conducted during the breeding season for most bird species (i.e., March 15-July 15), in compliance with the Migratory Bird Treaty Act.

Each proposed work site should be evaluated by contacting NPS wildlife biologists to confirm current wildlife status and verify the accuracy of habitat information contained in this plan germane to the decision matrices (Figure 5-1). These inquiries should be made in four areas, as described below.

Nesting Raptors

In April and May, the presence of nesting raptors at known or suspected nest sites identified in this plan or noted by park staff or visitors should be determined. Records for previous years should also be consulted. A located nest that has been used within the past 3 years should be considered potentially active.

A tree retention zone with a radius of 100 feet should be enforced around each active or potentially active nest site. During nesting periods, no trees should be cut within 300 feet of a nest.

Other Critical Habitat Elements for Special-Status Species

NPS biologists should be consulted to determine if other forest components have been found to be critical habitat of any special-status species, and appropriate avoidance measures should be taken.

General Wildlife Habitat Value

In conjunction with stand remapping, the relative wildlife habitat value of stands proposed for removal should be verified. Key habitat qualities shown in Table L-4 of Appendix L should be reviewed, and the value conclusions shown in Figure 3-10 should be confirmed. A stand that has high wildlife value should be retained unless native oak or serpentine habitats can replace it, according to the prehistoric vegetation pattern shown in Figure 2-1.

Native Habitat Restoration Potential

In addition to determining retention or removal of stands with high value for wildlife using replacement habitat type data shown in Figure 2-1, feasibility of native habitat restoration should be determined. This is a subjective judgment based on size, configuration, accessibility, and potential for control of foot traffic at the potential restoration site. If a site is contiguous with a native vegetation community, restoration should usually be found to be appropriate. If not, a determination must be made on whether an isolated native plant community at the site could be established successfully. If not, the stand removal site should be committed to landscaping grasses or shrubs.

Protecting Native Vegetation during Stand Removals

During stand removal operations, measures should be taken to protect native vegetation, particularly special-status plant populations. Appendix H, "Concepts for Restoration of Native Habitats at Forest Removal Sites on the Presidio of San Francisco", contains guidance for conserving existing native plant and soil resources within forest stands proposed for removal. Measures described in Appendix H and the measures that follow should be implemented during forest removal to prevent adverse effects on native vegetation:

- Salvage native plants from the forest understory before forest removal activities begin. This plant material should be moved to the native plant nursery or installed directly into restoration sites. Native plant salvage and the native plant nursery are described in Appendix H.

- Train tree removal crews to recognize native vegetation and educate them on the importance of avoiding native vegetation and rare plant species.

- Limit forest removal work areas to the forest stand and surrounding developed areas. Stands of native vegetation should not be included in work areas. No forest removal activities, materials storage, or debris dumping should occur in stands of native vegetation. Install temporary construction fences between forest removal sites and adjacent native vegetation. Post temporary signs if needed.

- Fell trees within the forest stand. Boles and limbs should not be allowed to fall on adjacent native vegetation.

- Monitor the activities of tree removal crews. The Presidio forester should be present during forest removal to monitor tree removal near native vegetation and redirect removal crews if necessary.

- Follow the erosion control measures described in the "Erosion Control" section of this chapter to avoid the indirect impacts of soil erosion and sediment deposition on native vegetation.

Removing Trees, Slash, and Stumps

All tree boles and chipped slash must be removed from native plant restoration sites. Boles should be taken to a Presidio log storage yard or trucked out of the park (see "Woody Debris Disposal" in this chapter and Chapter 7, "Recovery and Use of Wood Resources"). Chipped slash should not be used at native plant restoration sites; it can be stockpiled or used immediately in forest regeneration or reestablishment sites. (See "Carrying Out Tree Removal" in this chapter for further discussion.)

Stumps on dune soils can be removed, but those on other soil types should be left in place to avoid soil compaction; however, they can be ground. All stumps should be cut flush to the ground. Sprouts of eucalyptus, acacia, and redwood should be treated with herbicides. See Appendix H.

Restoring Native Vegetation

Options for restoring native vegetation in place of the removed historic forest are described in Appendix H. Those options include:

- general restoration concepts and methods, including site preparation, planting, irrigation, and weed control;

- restoration methods by habitat type; and

- restoration recommendations for particular stand-removal sites.

These treatment options should be implemented. A restoration plan reflecting these guidelines should be prepared for each site during the season before the anticipated work begins.

PROTECTION AND MANAGEMENT OF NATIVE VEGETATION

Purpose

The purpose of protecting and enhancing native vegetation is to ensure the persistence of locally rare native habitats.

Primary Approaches

Management should involve three primary actions: preventing damage to native vegetation from human activities, reducing competition from introduced invasive species, and expanding habitats of specific communities and populations of specific species.

Damage prevention measures should include the following:

- posting interpretive signs to describe the communities present and explain the need for protection,
- eliminating vehicle access where evidence of past intrusion is apparent,
- installing designated walkways or fencing where pedestrian traffic is degrading vegetation, and
- preventing runoff from offsite areas from draining through these sites.

Invasive vegetation should be controlled by:

- cutting back invading tree stands to their historic boundaries or pruning low branches on trees adjacent to native plant communities, which generally require full sunlight, and
- grubbing out invasive species repeatedly when volunteers can be assembled.

Practices for Protection and Enhancement

Two appendices of this plan provide detailed guidance for management of native plant communities. In Appendix H, the section "General Restoration Concepts and Methods - Aggressive Weeds" describes general control measures for invasive vegetation. Appendix I, "Rare Plant

Enhancement Recommendations", describes species-specific enhancement measures that address damage prevention, weed control, and population expansion. The preceding section, "Forest Removal", provides direction for expansion of native communities.

FOREST MAINTENANCE AND REGENERATION

In Chapter 5, portions of the Presidio forest recommended to be maintained and regenerated when needed were allocated to one of the two options described below.

Intensive Management

Purpose

The purpose of this treatment option is to maintain certain historic forest stands as long as possible and then to regenerate them after stand damage in a way that will replicate, as nearly as possible, their historic character. For areas where the historical forest borders landscaped areas, the Presidio forester and historical landscape architect should collaborate to delineate appropriate treatments, based on the following guidelines.

Near-Term Management - Sanitation Cuttings

The process of extending the life of these 100-year-old stands as they approach and undergo senescence will require constant, careful monitoring and prompt removal of diseased, insect-infested, or severely damaged trees. This care may require frequent reentry into some stands to remove the dead, damaged, diseased, or infested trees or portions of trees and prevent the spread of pests or pathogens. Chapter 3 and Appendices B, F, and G provide information about forest pathogens and hazard tree removal, cabling, and pruning, upon which the following sanitation cutting options are based.

Other techniques to improve the vigor of late-maturity stands are available and should be considered in particular years or locations. These treatments should be performed on an experimental basis, requiring that careful observations be made and recorded of conditions before and after the treatments. During drought periods, these stands should be watered deeply in the spring, especially those in relatively high topographic position. Care should be taken during watering to prevent soil from washing downslope. Where soil compaction is evident from past land use, soil tilling may be beneficial to increase gas exchange in the soil surface horizon. Where soil chemistry testing shows a lack of essential nutrients or very low pH in these low-vigor stands, fertilizers or lime should be applied.

The historic stands should be protected from human damage by excluding vehicle access, even by maintenance crews; establishing designated footpaths; and discouraging offpath walking by erecting barriers or posting interpretive signs at points of likely pedestrian entrance.

Regeneration Threshold

Many of the low-vigor stands can be expected to survive with this additional care through 2010, but their persistence in decades beyond is doubtful.

Sanitation cutting and substrate manipulation should continue until an adopted threshold of tree loss is exceeded. An appropriate threshold may be when 40% of the trees that were present during the 1984 inventory have died or been removed. Thus, when more than 40% of the trees in a stand or other visually distinct area have died or been removed, regeneration would begin.

An alternative threshold criterion is basal area of remaining trees. (Basal area is the aggregate cross-sectional surface area of the boles of all trees in a stand, measured 4.5 feet above the ground.) Once the density of trees in a stand falls below an average basal area of 100 square feet per acre, the stand could be considered in need of regeneration.

Regeneration Cutting

Once the established threshold of tree loss within a stand has been exceeded, regeneration should be initiated. Regeneration involves clearing small areas of the remaining decadent trees in and adjacent to the areas in which regeneration has been lost. Openings should be limited in size and dispersed to avoid windthrow, maintain windbreak function, and limit visual impact. They must, however, be at least large enough to allow adequate light to reach the ground for vigorous seedling growth. Openings should therefore be about 0.3-0.5 acre.

Configuring Openings. The configuration of a regeneration cut area depends on the configuration of the area in which vegetation has been lost, but also on plant physiological requirements, wind conditions, historic planting patterns, and potential visual impacts.

Openings that allow sufficient light to reach the ground for vigorous seedling growth typically should have a north-south dimension of at least twice the height of the adjacent canopy along the southern, southwestern, or southeastern edge of the proposed cutting area. For example, where the height of trees in the adjoining mature forest is approximately 75 feet, a typical height at the Presidio, an opening should be about 150 feet wide, or about 0.5 acre in size if square.

Wind can damage exposed, mature trees at the edges of openings where an open corridor, such as a road, allows funneling of wind through the site. Wind can also affect the survival of young trees in areas where an opening is large enough to allow concentrated airflow at ground level. The direction of the prevailing wind at the Presidio, from the southwest, dictates that openings should

not be created with the long dimension in the southwest-northeast direction. Ideally, the long dimension should be perpendicular to the prevailing wind.

The smaller the clearings for reforestation purposes in visible locations, the fewer will be the expressions of public concern toward tree cutting. This effect cannot be quantified, but this issue, as well as the potential for windthrow, suggests that a maximum opening of 0.3-0.5 acre should be used for regeneration cutting at the Presidio.

Infrastructure Considerations. Access routes for tree cutting and removal equipment need to be identified. Existing power, telephone, and water lines and other utilities must be avoided during regeneration cutting. Surfaced roads not designed for use by heavy equipment may need to be repaired after regeneration operations are finished.

Debris Disposal

Treating woody debris is the most expensive and time-consuming operation in preparing a regeneration site. Small limbs and branches should be chipped onsite and broadcast as mulch. Large stems should usually be moved offsite; see the "Woody Debris Disposal" section in this chapter and Chapter 7, "Recovery and Use of Wood Resources."

Regeneration Planting

General. Historic forest regeneration should generally involve reforestation with the species that composed the historic forest. These are the species that were originally planted according to the U.S. Army landscape plan and that proved able to adapt to conditions at the Presidio. These species are usually the species removed in the regeneration cutting described above. If removed species are suspected of having been established after the 1930s, historic documents and maps described in Chapter 2 should be consulted for indications of original species. As noted, however, only species that have survived well at the Presidio should be planted.

Historic forest regeneration also should involve replication of the original pattern and density of trees. In some stands, planting patterns were uniform, and such patterns should be maintained during replanting. If the spacing of a stand to be regenerated was irregular, trees should be replanted at varying intervals averaging 10 feet on center, for a density of about 430 trees per acre for all species. If some substrate types or exposures prove difficult to reforest, planting densities should be increased for subsequent regeneration projects with similar conditions.

Refer to "Planting and Reforestation" and "Reforestation Maintenance" below for descriptions of suitable reforestation practices.

Eucalyptus. In a few cases, eucalyptus stands may require regeneration, although relatively few eucalyptus stands exhibit low vigor. Because eucalyptus usually sprouts vigorously from its

roots when cut, sprouts can often be selectively controlled to replace the trees removed from the original sites. However, 100-year-old root systems make up the originally planted trees. A certified arborist should be consulted on a stand-by-stand basis to examine root crowns and determine whether replanting or sprout management should be used to regenerate historic eucalyptus stands. Stumps should be cut at ground level to ensure that sprouts are well anchored to root systems.

If sprout management is used, sprouts will need to be pruned at least annually, with the most vigorous growth gradually selected and less vigorous competitors eliminated until a single new tree is established. More than one sprout should initially be nurtured, preferably on opposite sides of the cut stump, until the emerging canopies of sprouts begin to compete for sunlight.

In no case should herbicides be used to suppress unwanted sprouts. Although glyphosate should be used for sprout suppression in forest removal sites (see "Forest Removal" above), this herbicide translocates and will attack the root tissue. All sprouts not retained will require hand pruning.

Gateway Plantings. When the historic gateway plantings deteriorate substantially and require regeneration, a site-specific plan that appropriately replicates the historic plantings should be prepared by a landscape architect.

Nonintensive Management

Purpose

The purpose of this option is to perpetuate indefinitely certain forest stands in a manner that will promote naturalization of planted forest species, enhance wildlife values, and reduce regeneration and maintenance costs. Although increased structural and species diversity are goals of this management treatment, the retention of historic species as dominants in the historic forest stands is an essential objective.

Nature of Treated Stands

This option could apply to certain historic stands identified in special management area goals and to certain nonhistoric stands retained for wildlife values, as described in Chapter 5. They comprise about 63 acres of eucalyptus stands and 44 acres of Monterey pine and cypress stands (28 acres of mixed pine-cypress stands, 11 acres of cypress stands, and 5 acres of pine stands) (Table 6-1).

Most of the eucalyptus stands have moderate to high vigor, although 5 acres of low-vigor stands are included. The vigor of the pine and cypress stands varies, but the largest stand is 20.5 acres of mixed pine-cypress with low vigor. All of the eucalyptus stands exhibit some natural

Table 6-1. Stands Recommended for Nonintensive Management

Stand Number	Forest Type[a]	Wildlife Rating	Special Management Area	Acreage	Regeneration Species[a]	Average Number per Acre: Seedlings	Average Number per Acre: Saplings	Stand Vigor[b]	Soils-Geologic-Vegetation Units[c]
9	E	H	None	0.7	E	0	20	M	2111,4411
10	E	M	None	0.4	E	0	20	M	2111,4411
17	CP	L	27	0.7	C	5	25	L	4411
48	E	H	15	2.2	E	40	0	M	2211
52	C	M	12	3.8	P	60	200	H	2211, 4411
53	E	H	12	6.6	EP	840	600	H	2211, 2221, 2222, 4111, 4611
56	C	L	12	1.4	None	0	0	L	2211, 4111
62	P	M	12	0.4	None	0	0	H	2211
63	E	H	12	0.4	E	0	100	M	2211
64	E	H	12	4.0	EPA	40	140	M	2211
77	E	H	11	3.8	EPA	10	90	L	3111,3112
87	CP	M	15	4.2	C	0	70	L	2211,4311
92	E	H	None	22.1	E	0	140	M	2211,4311
93	E	H	None	5.0	EC	0	670	M	2211
94	E	H	None	1.2	C	0	140	M	2211
95	E	H	12	3.9	EP	60	200	H	2211
105	R	M	None	0.6	None	0	0	L	4111
106	RPC	H	None	0.7	EAC	8	528	H	4111
108	C	M	None	0.2	None	0	0	L	3113,4111
09	E	H	None	4.9	E	40	226	M	3111,3112,3113,4111,4211
119	C	M	2	2.1	C	10	0	M	2211
120	P	M	2	1.2	None	0	0	M	2211
136	C	H	5	1.1	None	0	0	H	3113,4111,4311
69	C	M	5	1.5	None	0	0	L	2211, 2222
0	C,P	H	2	20.5	None	0	0	L	2211
171	P	M	2	0.4	None	0	0	L	2211
172	E	M	2	1.6	E	0	8	L	2211
173	P	M	2	1.1	None	0	0	L	2211
174	C,P	M	2	1.6	None	0	0	M	2211

Table 6-1. Continued.

Stand Number	Forest Type[a]	Wildlife Rating	Special Management Area	Acreage	Regeneration Species[a]	Average Number per Acre: Seedlings	Average Number per Acre: Saplings	Stand Vigor[b]	Soils-Geologic-Vegetation Units[c]
201	E	H	6	5.9	E	12	7	M	2211, 3111, 3114, 3211
209	C	L	6	0.4	None	0	0	0	2211, 3111
210	C	L	6	0.6	None	0	0	M	2211
489	C,P	NR	2	0.5	NR	NR	NR	NR	2211
492	E	NR	2	0.4	NR	NR	NR	NR	2211
531	P	NR	2	0.2	NR	NR	NR	NR	2211
533	P	NR	2	0.1	NR	NR	NR	NR	2211
535	S	NR	5	0.2	NR	NR	NR	NR	2211
538	A	NR	5	0.1	NR	NR	NR	NR	2211
539	P	NR	5	1.6	NR	NR	NR	NR	2211, 2221, 2222
540	P	NR	5	0.1	NR	NR	NR	NR	2211, 2222
Total Acreage				108.4					

Notes: NR = Not rated.

[a] Species:
- A = acacias.
- C = Monterey cypress.
- E = eucalyptus.
- P = Monterey pine.
- R = redwood.
- S = Scotch pine.

[b] Stand vigor ratings:
- H = high.
- M = moderate.
- L = low.

[c] See Table 3-1 for locations of soils-geologic-vegetation units.

regeneration, usually extensive. The pine and cypress stands, on the other hand, commonly show no regeneration, although some of the cypress and mixed pine-cypress stands contain a substantial number of seedlings and saplings.

Adaptive Management

Although all forest management must be adaptive, this option should be considered as an exercise in adaptive management, requiring a more experimental approach than the more intensive management options discussed above. Application of this option should be preceded by evaluative design and followed by monitoring to provide feedback for appropriate management changes.

Major Issues. Two important issues attend the use of this option: how Monterey pine and cypress stands can be encouraged to naturalize successfully at the Presidio or be regenerated through low-cost approaches, and how fire risk can be adequately managed at a reduced level of maintenance. This option assumes that prescribed fire will not be used at the Presidio to encourage pine and cypress regeneration or to reduce fuel loads because of high risks associated with potential loss of control.

Evaluating Regeneration Factors. As described in Chapter 3, several factors appear to affect the regeneration of Monterey pine and cypress at the Presidio, which has generally been limited. In contrast, eucalyptus has demonstrated a propensity for naturalizing in a wide variety of habitats. The importance of various possible factors limiting pine and cypress regeneration is based on impressions of several observers and has not been evaluated systematically.

Key factors in pine and cypress regeneration appear to be the presence of both stand canopy openings to admit light and mature trees to generate fog-drip precipitation. Factors that seem to contribute to regeneration are thickness of the forest litter layer and degree of competition from annual grasses. Several other factors that may affect regeneration but are of unknown significance are soil factors (e.g., type, depth, pH, temperature, presence of soil mycorrhizal associations, and allelopathy under eucalyptus stands), rate of cone opening and seed release, seed dispersal by animal activity, seed herbivory, slope aspect, and proximity to the coastline. Activities undertaken according to this option should be designed and monitored to allow a systematic assessment of the actual importance of these factors for regeneration of pine and cypress at the Presidio.

Use of Volunteers. Implementation of this option would allow for substantial use of NPS volunteers. The low-maintenance approach requires some labor-intensive efforts requiring only brief training, for which volunteers are well suited. The experimental nature of some of the actions under this option calls for monitoring, a task suited to trained volunteers. Volunteers should favor this option because of the unique challenges and opportunities it presents.

Sanitation Cuttings

Unlike more intensive forest management options, tree-removal operations should be minimized as a part of the low-maintenance requirement of this approach. Thus, sanitation cuttings and tree removal should be used only if one of the major emerging pathological threats to the Presidio's trees (described in Chapter 3) materializes. In the absence of such an outbreak, tree removal should be limited to protection of visitor safety. In general, senescent and dead trees should be retained, and trees that are cut or allowed to fail should be left to decompose onsite.

Eucalyptus Management

The Presidio's eucalyptus stands have a strong tendency to naturalize, often expanding into adjacent native plant habitats. Relatively little effort will be needed to promote eucalyptus regeneration, and management efforts should focus on containment and increasing structural and species diversity.

Containment. Eucalyptus should be constrained from expanding beyond current stand boundaries through eradication of volunteer seedlings and saplings. Stems should be cut at least annually and painted with glyphosate to prevent sprouting.

Increasing Structural Diversity. Where stands are even aged, a diversity of age classes can be developed through felling of small groups of trees. A young age-class group would develop through stump sprouting. This treatment should be applied only where branches and foliage can be chipped and disposed of onsite. Eucalyptus boles can be left onsite or removed and sold if such efforts are cost effective.

Increasing Species Diversity. Eucalyptus stands tend to be monotypic, excluding other species. This situation cannot be changed without intensive management. However, in a few stands where other tree species are present in the understory (e.g., acacia, Monterey pine, and Monterey cypress), openings in the eucalyptus canopy could be made or enlarged through cutting of individual trees, taking care not to fell trees on the desirable understory vegetation. Branches and foliage should be chipped and disposed of among the remaining eucalyptus. This practice should be pursued only where stand conditions are optimum.

Monterey Cypress and Monterey Pine Management

In the absence of fire, the Presidio's Monterey pine and cypress stands have little tendency to naturalize. Relatively large effort will be needed to promote their regeneration, and management efforts should focus on both natural and low-cost artificial regeneration.

Enhancing Natural Regeneration. Natural regeneration should be encouraged as much as possible under this option. To this end, the forest floor should not be mowed within allocated

stands, and large woody debris should not be removed (see "Fuel and Fire-Start Management" below).

A program of regular regeneration maintenance should be established, involving annual inspection and maintenance of individual seedlings and saplings that have established naturally. Annual grasses and other weeds should be removed, perennial weeds should be treated with glyphosate, and the soil surface should be mulched within 2-3 feet of each seedling or sapling. Shrubs and midstory and overstory branches of mature trees should be trimmed, where this can be accomplished easily, to promote fuller penetration of sunlight to target plants. In general, stand decadence should be relied upon, rather than cutting of mature trees, to provide canopy openings.

Plantings. A regular winter planting program should be established for pine and cypress seedlings within stands showing little or no regeneration. Planting sites should be selected by the implementing forester or trained staff and marked for planting crews. Planting sites should be located systematically to test the validity of present impressions of regeneration success factors.

Based on observations described previously, planting sites should initially be selected at the dripline of mature trees where canopy openings are present. The basic strategy is to select sites where existing vegetation, aspect, and topography combine to cause the collection and retention of soil moisture during the rainless but foggy growing season (irrigation will not be provided). Openings created by the loss of mature individuals should be given emphasis as planting sites, but stand decadence, rather than tree cutting, should be relied upon to provide canopy openings. Planting rates should be relatively high.

Before planting, forest litter, annual grasses, and other weeds should be removed; perennial weeds should be treated with glyphosate; and the soil surface should be mulched 1-3 inches deep and within 2-3 feet of each planting location with chips from other stands. Seedlings should be planted as described below under "Planting and Reforestation". Seedlings should be watered upon planting, although planting should occur when soils are already moist.

Seedings. In conjunction with the annual planting program, salvaged seed can be sowed. An ongoing cone salvage and storage program should be established for this purpose. Unopened cones can be heated to approximately 100°F, causing them to release seeds.

Maintaining Plantings. Because postplanting irrigation would be a major expense, it should not be employed under this treatment option. Other care should be given, however, as prescribed above under "Monterey Cypress and Monterey Pine Management—Enhancing Natural Regeneration".

Increasing Species Diversity. Historic stands should generally be planted using the historic species in their relative historic abundances. Species diversity should be increased, however, by using mixed pine-cypress plantings in pure pine or cypress stands, as well as an occasional group of coast live oak.

Fuel and Fire-Start Management

The primary approach to fuel management in stands allocated to this option is to isolate them from structures, other improvements, and other stands through development and maintenance of fuelbreaks. For larger stands, a network of interior fuelbreaks may also be developed. Fuelbreaks should comprise gaps in tree canopies, mowing of annual grasses or other groundcover, and removal of woody debris. Fuelbreak widths should vary on a site-specific basis to take advantage of roads and other nonforest areas. The fuelbreaks should be planned to slow the spread of fire beyond the ignited stand.

The second approach to fuel management is to eliminate fuel ladders within stands where this is consistent with regeneration efforts described above. These stands should be treated annually to reduce fuel connections between the forest floor and canopy, using manual removal and manual or small power-tool cutting. In particular, litter and vines that are draped on shrubs and understory trees or low limbs of larger trees should be eliminated. Where trees have fallen, limbs and foliage projecting into or near the adjacent canopy should be cut and felled to lie as close to the ground as possible. Areas within about 15 feet of fuelbreaks should be given most emphasis.

Fire-start management of stands allocated to this option should entail minimizing trails and inducements to human access in general. The use of public notification or further access restrictions based on a daily burning index (measuring fire hazard condition) should also be considered.

Fire management related to forest stands in general is discussed below under "Fire Protection".

Wildlife Habitat Development

Stands allocated to this option should be considered for wildlife habitat enhancement projects, as long as historic tree species retain dominance in historic forest stands. Examples of compatible projects include the following:

- development of coast live oak groves to increase insect production and
- development of moist herbaceous layers, blackberry thickets, or fern populations, using artificial or natural water sources, to increase rodent populations to support raptor nesting and foraging.

CARRYING OUT TREE REMOVAL

All tree removal operations at the Presidio should be planned to avoid disturbance to breeding birds. Tree removal should be prohibited from March 15 through July 15 annually. Individual trees may be cut during this period if surveys for breeding birds in the vicinity are performed first and no adverse effect on breeding birds is anticipated.

In addition to the biological and sociological considerations in an urban environment, many obstacles may hinder the removal of large trees. Improvements and surrounding vegetation should be protected from damage during removal operations. Locations of structures (e.g., fences, buildings, and parking lots), overhead or underground utilities, usable access routes, erodible soils, and hazardous trees on the site must be determined. Depending on the problem, appropriate personnel (e.g., plumbers, iron workers, and masons) should be contacted to perform required site preparation work. Specialized laborers, such as heavy equipment operators, truck drivers, and skilled arboricultural or silvicultural crews, should be contacted and specific equipment assembled.

Tree cutting is dangerous, and every site presents unique hazards. All employees should be made aware of site-specific hazards. Plans for the safety of passersby should be developed and implemented as well.

Members of the public can disrupt and delay a project if they are not given adequate, reliable, and prompt information about the work. On highly visible projects, or where the potential exists for public opposition, the work crews and the NPS public relations officer should be informed about the reforestation plan. Neighborhood associations should be notified before tree removal operations are conducted adjacent to homes or roadways.

Because every site is unique, cutting procedures must be developed on a case-by-case basis. Emergency actions for dealing with unexpected events should be considered. In general, access must be developed, brush cleared, trees removed, woody debris treated, and the area cleaned up and prepared for replanting.

Regeneration sites cannot be replanted until winter. This requires that each site be protected in the interim from unauthorized uses such as auxiliary parking, picnicking, and off-road driving because, once established, these uses often continue after the site is planted. Protection of sites needs to continue until the forest is reestablished and risk to seedlings and saplings from recreational use is eliminated.

LANDSCAPING MAINTENANCE AND HAZARD TREE MANAGEMENT

Landscaping trees are those that do not occur in forest stands but stand alone or in small groups near buildings, within parks and recreation areas, and along roads and parking areas. Accordingly, these trees have relatively high aesthetic value. These trees also present the greatest threat of injury to people or damage to property because they are in high-use areas. Many of the landscaping trees at the Presidio are senescent and are at increasing risk of failing structurally.

For several special management areas, the present landscaping values should be perpetuated through replacement cuttings, replanting, and coppicing or sprout management. Many landscaping trees are rated as potentially hazardous (see Chapter 3), and treatment is needed to provide safe conditions for users of the park.

General Landscaping Maintenance

General landscaping maintenance includes groundcover maintenance, debris and fuel removal or treatment, and tree and shrub maintenance. In general landscaping areas, these activities should continue.

All tree maintenance should be directed by the implementing forester or a certified arborist hired for this purpose. Many of the landscaping trees on the Presidio have been or will be inventoried under the hazard tree management program described below. Landscaping trees should be pruned on a regular basis. Pruning practices and other treatments for hazard trees, and landscaping trees in general, are described in Appendix B, especially Appendix 4, "Specifications for Tree Work". All tree treatments should be recorded in the hazard tree inventory. In the event of future litigation for personal injury or property damage, these records can help document reasonable and prudent maintenance of the Presidio's landscaping.

Two changes should be made to past landscaping maintenance practices at the Presidio:

- ivy and other groundcovers should be removed on and within 3 feet of landscaping trees, and these areas should not be watered frequently; and
- trees should be irrigated less frequently than in the past, using more water during each application.

Specific actions must be consistent with the Standards for the Treatment of Historic Property with Guidelines for the Treatment of Cultural Landscapes (Secretary of the Interior 1996); the National Historic Landmark nomination; and other historic values. Landscaping trees and shrubs that are not considered part of the historic forest, are not heritage trees, or are not historically

significant can be replaced in kind or with other species. New species should be selected based on their adaptation to the peninsula climate zone and the microclimate of the Presidio; tolerance for site-specific moisture conditions; propensity for defects or disease; invasiveness in the Bay Area climate; and aesthetic features, such as surrounding vegetation patterns, evergreen or deciduous habit, showy fruit, showy flowers, or fall color.

In general, each landscaping tree removed should be replaced with another tree in the same location. In selecting replacements, consideration should be given to ultimate tree height and canopy spread in relation to buildings and other structures. Root morphology in relation to available rooting space, resistance of buried and nearby surface improvements, and soil strength should also be considered.

Shallow-rooted species such as Douglas-fir and Monterey cypress should not be planted in cohesionless, sandy soils in locations with abundant moisture. Species likely to disrupt surface or subsurface infrastructure, including acacia, Monterey pine, and eucalyptus, should generally not be used outside of the historic forest (Figure 2-3). Black acacia (*Acacia melanoxylon*) and pink ironbark (*Eucalyptus sideroxylon*) should be avoided wherever possible because of their susceptibility to branch breakage and decay. A landscape architect should be consulted regarding all landscaping replacement.

Maintaining Landscape Screens

Screen Functions

The functions of screens on the Presidio are to separate residential spaces from public use and activity areas, obscure views of maintenance facilities, provide pleasing landscaping for users of the park, and buffer areas from highway noise and glare. With regard to the latter, vegetation can be effective in screening headlight glare, removing a major component of the invasiveness of nearby highway travel. Potential reductions in noise levels afforded by vegetation alone, however, are generally much more modest.

Screens may be categorized into two groups, visual and acoustic screens and golf course screens. Visual and acoustic screening is provided with the use of low tree canopy and shrubs. Golf course screens also demarcate the golf course and separate it from the built environment, as well as protect people, vehicles, and buildings from damage by errant golf balls. Both types of screens often also serve as windbreaks.

Regenerating Landscape Screens

The average vigor of trees in screening stands, especially the golf course screens, is better than the average for the Presidio forest as a whole. Three approaches are available to regenerate

screens: replacing shrubs and trees upon loss; underplanting older, low-vigor screens on a scheduled basis; and coppicing trees that have lost their screening value because of upward growth.

Replacing upon Loss. In this approach, each screen shrub or tree that fails is replaced at the next opportunity. Replacement shrubs and trees should generally be from liners or bare-root stock for maximum growth rates and minimum cost. However, container stock may be used if immediate screening is deemed necessary. As many as three replacements can be planted for each individual plant lost. Replacement species should usually be the same as the lost species, unless several individuals of the same species have been lost simultaneously and are determined not to be historically significant. In this case, consideration should be given to replacing all individuals of that species in the screening stand.

Underplanting. The long-term approach to screen regeneration is to underplant the existing screens and remove the overmature screen trees when the understory is established. Bare-root sapling stock should be used for underplanting. Two or three saplings should be planted for each mature tree to be replaced, usually of the same species. Because screens are often narrow strips of vegetation, light reaching these shrubs and trees usually will be sufficient for their growth. In cases where light is insufficient, limited pruning of the existing screen should be done. Underplanting also allows for experimentation with new screening species because failure of replacements to establish does not lead to loss of the existing screening function.

Coppicing. In some cases, trees that originally served a visual and acoustic screening function have grown to such a degree that their canopy is too high to be effective. Coppicing can be used in some cases for low screen regeneration. This technique can be used on redwood, acacia, and especially eucalyptus because these species sprout from cut stumps. After the mature trees are removed, sprouts are selectively thinned to develop low, brushy growth. The process can be repeated several times before root systems become senescent; four short-rotation generations of eucalyptus can be grown from the original root system without deterioration. Stumps should be cut at ground level to ensure that sprouts are well anchored to root systems. Coppicing and removing sprouts, however, is labor intensive.

Priorities. Coppicing should be undertaken to restore selected screens as soon as possible. A landscape architect should guide the selection of these projects. Underplanting should be scheduled for low-vigor screens and the program should commence. Replacement plantings should be ongoing, as individual trees are lost.

Identifying and Maintaining Heritage Trees

A program to systematically identify and manage heritage trees at the Presidio has not been established but should be considered. The purpose of such a program would be to identify landscaping trees that should be maintained as long as possible and regenerated in kind when mortality occurs. Otherwise, these trees would be subject to the other provisions of this section,

which allow earlier removal and replacement with other species. Consideration should be given to establishment of progeny before senescence or loss.

Identifying and Treating Hazard Trees

An inventory of the Presidio's hazard trees according to NPS guidelines must be completed and treatment actions scheduled and carried out.

Inventory

The Presidio hazard tree inventory (Appendix B), summarized in Chapter 3 under "Present Forest Condition and Hazards", was completed in 1995 and should be updated on a rotational basis every 3 years. It should continue to be the mechanism for assessing tree hazards and arranging treatment priorities.

Priority of Treatment

The hazard rating of each tree, as described in detail on pages 3-5 of Appendix B, is based on a combination of tree defect and the duration of human exposure to the hazard. That rating system is a standardized system used throughout the NPS western region (Appendix B). At the Presidio, ratings range from 2 to 7 and ratings of 4 or higher are considered potentially hazardous. Trees rated 7 should be treated within 10 days. Trees rated 6 should be scheduled for treatment in the next fiscal year. Trees rated 5 should be treated in the ensuing 4 fiscal years. Trees rated 4 or below should be inspected annually and ratings confirmed or amended.

Treating Tree Hazards

Five methods of treating hazard trees are described in Appendix B, and the method applicable to each hazard tree is identified:

- pruning to clean,
- pruning to thin,
- thinning and cabling,
- removing tree, and
- removing target.

These recommendations are based on current standards for arboricultural practice. Specifications for these treatments are given in Appendix 4 of Appendix B.

Pruning to Clean. This treatment is the removal of dead, dying, weak, diseased, and rubbing branches from the crown.

Pruning to Thin. Crown thinning is the removal of live branches to reduce weight and windsail. Trees adjacent to openings naturally have grown toward these spaces, developing lopsided crowns. Pruning the heavier side of the crown redistributes a tree's weight. The crown of a tree that is subject to windsail and potential windthrow can be pruned by removing as many as every third limb, allowing wind to pass more easily through the tree.

Thinning and Cabling. Cabling is recommended where the tree is considered important enough to remain in the landscape and where cabling would reduce the hazard to an acceptable level of risk. Cabling can extend the life and preserve the form of heritage trees for several years if the cable system is inspected biannually and is maintained.

Removing Tree. Trees are recommended for removal when they are considered to be in poor health or to have such poor structure that pruning would not alleviate further hazards. Boom trucks are used to perform most pruning and tree removal work, but the tops of eucalyptus trees can exceed the reach of the highest boom truck. Thus, climbers must be used, and two should be present on the site at all times.

Removing Target. In some cases, targets can be removed easily to alleviate the hazard. Play yards, picnic tables, bus stops, and benches can be relocated inexpensively. Temporary buildings, utilities, and parking areas can also be moved if an adjacent heritage tree is rated as hazardous.

PLANTING AND REFORESTATION

Planting and reforestation practices described in this section are manual tree-planting methods to restock trees in the existing forest stands, create new stands, and replace landscaping trees. Planting of native vegetation, including native woodland and forest, is described in Appendix H. Forest or tree planting must be followed by planting maintenance, which is described in the following section.

Preparing Soils

Erosion Control

Practices for erosion control are described in detail under "Erosion Control" below. Litter layers and soil surface horizons should be disturbed as little as possible during regeneration cutting.

Litter layers should be removed after forest removal where native vegetation will be established (see Appendix H).

If they have not already been implemented, measures should be taken to reduce or eliminate erosion at critical sites before planting begins (see Figure K-1 in Appendix K). These include redirecting drainage, filling or repairing gullies, establishing some footpaths and abandoning others, and applying clay and lime amendments to Sirdrak soils and tilling them into the topsoil to reduce soil hydrophobicity and runoff from Sirdrak soils.

Soil Amendment

Soil Fertility. Soil fertility and productivity depend partially on geologic parent material and soil type. Natural imbalances of nutrient in serpentine-derived soils will continue to restrict the establishment or growth of many plant species. Sandy soils low in clay content have low cation exchange capacity and low available nutrient capacity; growth rates will continue to be relatively slow.

Organic matter content and nutrient cycling of decaying organic matter are the principal sources of plant nutrients for the Presidio forest. Preventing loss of the litter layer and surface soil horizon is the most effective means of maintaining soil fertility. The next generation of trees should grow somewhat more quickly than the original forest because of a small improvement in water-holding capacity and cation exchange.

Improving Soil Fertility. Soil pH should be measured at several locations in each planting area. Maintaining a moderately acidic to neutral pH permits optimal availability of plant nutrients. Lime may be used to change pH and should be applied for marked imbalances. A montmorillonitic clay (not derived from serpentine soils) and/or organic matter could be applied to the sandy, Sirdrak series soil to increase its water- and nutrient-holding capacities.

Slow-release fertilizer pellets (e.g., 6- to 9-month 14-14-14) should be placed near the bottom of each tree-planting hole.

Mulching

Soil should be mulched from chips at the time of stand cutting, and mulching should be maintained continuously if the supply of chips allows. Mulch will reduce weed competition, increase soil moisture levels, and inhibit soil erosion.

Forest litter in some stands can be used for mulch, but at the Presidio only the eucalyptus trees have produced much litter, and eucalyptus litter acts as a growth suppressant because of allelopathy, inhibiting survival and growth for seedlings of other species.

Wood chips in conjunction with weed cloth is the most desirable mulch to use for forest regeneration purposes. Before wood chips are applied, groundcover at the planting site should be turned into the soil. As a supplement to wood chips, permeable woven plastic sheets (3 feet by 3 feet) should be used for weed control at each planting site. The chips can be placed over the plastic to reduce visibility and vandalism.

Selecting Planting Materials

Genetic Considerations

The genetic stocks of the Presidio's historic forest are not local, but their origin has not been researched. Whereas species that have successfully established are generally adapted to the Presidio's climate and soils, further adaptation through genetic change and natural selection in the naturally regenerating stands cannot yet be appreciable. Thus, the location of origin of Presidio planting stock for non-native forests is not an issue in forest regeneration or establishment, and the use of seed or stock from the present Presidio forest is not necessary. Trees with good genetic characteristics, such as superior aesthetic form, excellent branching habit, and longevity, should be selected as sources of planting materials.

Types of Planting Stock

The best seedling is the youngest nursery-grown tree that is practical to plant in an urban area. Larger seedling sizes may be necessary in highly visible areas. Nursery stock comes in three forms: bare-root stock, liner stock, and container stock.

Bare-Root Stock. One-year-old bare-root seedlings should be the basic stock used in replanting the Presidio forest. This seedling stock is the same type used in the initial planting of the Presidio forest. Bare-root stock seedlings generally perform better than other stock because root growth has not been inhibited in the nursery.

Liner Stock. Liners are plastic sleeves that allow uninhibited downward growth of the seedlings' tap roots. They are used to root seeds, and the resulting seedlings are ready for planting when they are only a few weeks old. Liner stock performs as well as bare-root stock but may cost more. Liner stock should also be considered for widespread use at the Presidio.

Container Stock. Container stock is generally inferior to bare-root and liner stock because root growth has been inhibited to some degree. Although the planted stock is larger, performance will be markedly inferior in comparison to that of the bare-root and liner stock. As such, container stock should be used only where immediate replacement of high-visibility planted stock is needed.

The most common container stock is the 1-gallon-container tree. By the time a tree has reached this container size, it has usually been transplanted three times. In contrast, a 15-gallon-container tree has a poor chance of growing into a strong, healthy tree. In larger container stock (i.e., 15 gallons or larger), roots tend to encircle the root ball and girdle the tree later in life.

Condition of Planting Stock

Seedlings should be young, healthy, and vigorous. The initial cost of a seedling is small compared to the cost of planting and maintenance. A seedling in poor condition will not become a strong, healthy tree and should be discarded.

Trees purchased from a nursery or grown in-house should be personally selected by the implementing forester. Representative trees of the potential planting stock should be inspected to determine the extent of their roots, their root-to-shoot ratio, evidence of stem and foliage diseases, and their overall development.

Planting

Planting should be done generally in December, January, and February. A yearly calendar describing seasonal activities, including planting, is provided in Appendix M, "Forest Management Activity Calendar and Equipment". Planting should be directed by experienced planters under the supervision of the Presidio forester. Volunteer trainees should be used. Techniques for these planting steps are described below; further information on planting, especially landscaping trees, is given in leaflets published by the University of California, Division of Agricultural Sciences.

Preplanting Care

Trees should be brought to the planting site carefully to minimize stress. They should not be exposed to severe wind or excessive heat, as in an open vehicle.

When bare-root seedlings are moved from the nursery, they should be planted as soon as possible, at least within 48 hours. Containerized seedlings allow much more flexibility in planting timing but present a greater transport problem (200 containerized trees versus 10,000 bare-root trees per truck load). Containerized stock should be handled by the container, rather than by the stem, because stems may be injured by the weight of the root ball.

Bare-root trees should be planted immediately after they are removed from the nursery. If they cannot be planted immediately, interim steps should be taken, such as placing the seedlings' roots into a moist medium (heeling-in) or putting them in cold storage. During storage, the roots should be covered at all times and growth should be prevented.

Containerized stock, on the other hand, should be acclimatized to the local weather before planting. This will harden them while they are secure in their containers. The plants and containers should be protected from desiccation and extreme heat.

Planting Container Stock

For container stock, the planting hole should be twice the width of and no deeper than the seedling container. The sides of the hole should not be smooth or glazed (as is caused by augering in wet, clayey soils) because the tree roots will not penetrate this surface and will spiral inside the hole. The soil removed should be stockpiled.

All roots of the transplants should be inspected and the matted, dead, diseased, broken, twisted, and circling roots pruned. Inspecting and pruning the roots should be done very quickly because every minute of root exposure to the air results in a significant loss of root hairs. For most containerized nursery stock, vertical cuts should be made on opposite sides of the container-shaped rootball to deter root girdling.

Trees should be placed in the planting hole so that the root collar is 2-3 inches above final grade. Most container stock will be found planted deep in the container soil; soil should be removed from the stock to the top of the first major root. Set in the planting hole, the top of the root should barely be visible at finished grade.

As soil is backfilled, it should be worked around the roots so that they are not compressed into a tight mass, but are spread out and supported by the new soil beneath them. After each 3-4 inches of soil has been placed in the hole, the soil should be pressed around the roots with foot pressure, with care taken not to damage the roots.

If the soil is dry, water should be applied before, during, and after the planting. Postplanting watering will eliminate possible air pockets and settle the root ball into its final position.

Planting Bare-Root Stock

Planting bars, mattocks, western planting tools, and shovels are commonly used for bare-root planting. The hole should be a slit about 10 inches deep with a nearly vertical wall on one side.

A tree is taken from a moist planting bag, checked for root defects, and set into the ground by suspending it against the vertical wall slightly below natural grade. The primary concern in planting small trees is to make sure that all roots are not kinked upwards ("J" rooted). Roots should be spread out fanwise, and the hole should be filled by holding the tree in one hand and packing the soil in with the other. The planting should be completed by firmly packing the soil with foot pressure.

If seedlings have a poor root-to-shoot ratio, corrective pruning should be done to decrease the foliage. About a quarter of the foliage can usually be removed without affecting tree health.

Planting Site Finishing

Preparation for Irrigation. Where drip-system irrigation will not be used, a soil berm should be constructed around the planting to form a watering basin about 3 feet in diameter. In some areas of sandy soil, the addition of a clayey soil may be necessary to keep the berm from washing away. Chips applied as soil mulch should be backfilled into the basin, but not against the planted stock. (Drip-system irrigation is described in "Reforestation Maintenance" below.)

Weed Cloths and Seedling Tubes. Commercial weed cloth, a permeable plastic sheet, should be installed around each tree to inhibit growth of competing vegetation. A 3-foot by 3-foot square with a central, small X-cut should be used and a commercial seedling tube should be placed over the seedling and inserted into the cut opening. The tube allows light to penetrate but protects the seedling from herbivory and other physical damage.

Root Barriers. Rigid root barriers should not generally be needed at the Presidio. However, if sidewalk or pavement damage has been a problem at the location in the past, a plastic or copper screen can be placed 18 inches deep near the edge of the structural surface.

Staking. Staking should be used only when necessary to keep a stem upright, although single staking may be necessary to deter mower damage. To provide a support structure, two stakes should be placed outside of the root ball area on an axis perpendicular to the prevailing wind (generally from the southwest). Trees should be attached loosely to the stakes so that they bend a little in the wind. Stakes should be removed before the third growth season. Coniferous trees, such as Monterey pine, generally should not need staking. In areas where vandalism is a threat, three or four stakes can be placed around each tree.

Watering. A newly planted tree will need several waterings during the planting day and shortly thereafter, depending on weather. A watering basin should have been graded at the time of planting, or a drip irrigation system installed, as noted above. (Irrigation is discussed below.)

VEGETATION MAINTENANCE

This section describes the procedures needed to ensure that planted trees and shrubs will survive and grow to their full potential.

Reforestation maintenance involves eliminating competitive weeds, providing water during the dry summer months, monitoring tree growth and health, and thinning planted seedlings. Watering will depend on local sources and site access. Weeding intensity will depend on watering.

As seedlings become saplings, they will begin to compete with each other and, depending on site conditions, a thinning process will be needed. Each planting site will accordingly require a different maintenance approach.

Four maintenance periods can be distinguished:

- Planting to 1 Year - The first year of a seedling's life will determine whether it will be a thrifty tree or a sickly, suppressed tree that will be a long-term maintenance problem. The most important maintenance steps during this period are to water, weed, and monitor growth and health.

- 1-3 Years - The seedlings are constantly cared for through a rigorous watering and weeding program. Poorly established trees are eliminated, sites prepared again, and new stock planted. Obviously defective branch growth is pruned.

- 4-7 Years - The sapling stage requires careful thinning, weeding, monitoring, and preventive maintenance. The saplings are thinned and possibly pruned. If shrubs are to be interplanted, this occurs during this period. The trees should be able to survive without irrigation.

- 8-11 Years - The trees are integrated into the surrounding forest by additional thinning and removal of potentially hazardous branch growth. Revegetation maintenance is discontinued as saplings become well established.

Maintenance of Seedlings and Saplings

Irrigation

Drip irrigation systems or watering basins should be installed around each plant at the time of planting. Watering of seedlings for as long as 3 years will be cost effective and, in most locations, will be necessary to regenerate or reestablish the historic forest. By carefully monitoring weather and soil conditions, confining watering to seedling root zones, and keeping aggressive weeds to a minimum, the effort and cost of watering can be reduced.

Watering Rates and Schedules. Newly planted trees may need several waterings during the planting day and the days immediately following, depending on temperatures, precipitation, and soil conditions. During wet periods, little initial watering may be required. Watering should normally occur twice a week at first, then weekly.

Thereafter during the first growing season, an average of 2-3 gallons of water should be applied to each seedling three times per month during summer (June-September). Watering in spring should also be done if spring rains are not substantial. One watering in March and two waterings

per month in April, May, and October are normally required. The frequency of watering, as described, is more critical to seedling survival than is the amount applied. Watering should be initiated when the soil surface has dried below a depth of 4 inches.

During the second maintenance period (1-3 years), watering frequency can be diminished. Only one or two waterings per month may suffice between May and September. Watering may not be needed during the third summer.

Watering schedules and application rates should be adjusted as reforestation proceeds and experience is gained. If drip irrigation is used instead of periodic hand watering, the total seasonal water application will be less.

Water Sources. Several methods of delivering water to reforestation plantings should be considered on a site-specific basis, including:

A. conveyance through buried hoses from the Presidio water system to the site, employing a drip irrigation system or manual application;

B. delivery via tanker truck or tractor-drawn tank, employing manual application; and

C. delivery via tanker truck to onsite storage drums or portable tanks, employing a drip irrigation system or manual application.

Methods B and C would require vehicle access routes to the site for the 2- to 3-year watering period. Drip irrigation systems used in methods A and C could be reused at subsequent revegetation sites.

Method A could be used where a water system hose bib is within a few hundred feet of a revegetation site. Hoses may be buried temporarily to avoid vandalism, but this will cause gradual hose deterioration and limit hose reuse.

When a drip irrigation system is installed, four emitters should be placed at each tree, at the edges of the original root ball and near the stem.

Use of a single water delivery method throughout the forest should not be anticipated. The implementing forester should use a mix of systems as dictated by specific site needs.

Weed Maintenance

Removing weeds from around seedlings is one of the most effective ways to increase survival rates and lengthen the interval between waterings. A seedling must extend its roots below the weed root zone before it can survive on its own. Grass fires are also a constant threat to young seedlings, and weeding reduces the risk of fire.

Three methods of eliminating weeds are available: weeding by hand, applying herbicides, and rototilling. At the Presidio, hand weeding within 18 inches of seedlings should be the prevalent practice. However, when very aggressive weeds are present, such as Kukuyu or Bermuda grasses, herbicide applications such as glyphosate may be necessary. Timing of herbicide applications is extremely important to maximize their effectiveness and reduce usage.

Most weeds germinate in spring when the surface soil is moist and warm. By eliminating the weeds during this period (by hand or with a rototiller), competition for moisture will be prevented and well-rooted weeds will not have to be eradicated during summer.

Monitoring of Growth and Survival

One of the most important vegetation maintenance tasks is monitoring of seedling and sapling growth to evaluate plant vigor.

Stock or Planting Deficiencies. Occasionally, poor planting stock may pass an initial health inspection and be planted. Monitoring should identify this problem, as well as poor planting techniques and mediocre performance by a particular tree species.

Human Influences. Picnickers, joggers, hikers, bicyclists, and off-road vehicle users may create trails in a revegetated area and damage seedlings. A controlled footpath system should be established throughout the Presidio. Tree theft may be a serious problem, especially before Christmas. Controlling human use will minimize damage to the site and seedlings.

Pests. Numerous animals, insects, and diseases can injure or kill seedlings or attack mature trees. Some diseases, such as western gall rust, can infect a pine seedling, but the deformation will not be serious until the tree has senesced and becomes unhealthy, unsightly, or hazardous. The implementing forester should identify pests before they become epidemic. Maintenance crews should have a general knowledge of seedling physiology and stress-related symptoms.

Remedial Action for Seedling Losses

Damaged, defective, and poorly growing trees should be removed as soon as possible. Each reforestation area should be overplanted because of these potential problems. If a reforestation project suffers more than 50% mortality in the first 3-year period, a seedling replacement program should be initiated.

Before replacement can begin, the cause of failure must be identified. This will dictate the scope of the replacement project and whether additional site preparation, use of different planting stock, different watering and weeding schedules, or other actions need to be taken.

Thinning of Saplings

Trees in crowded stands tend to grow slowly. Indications of the need to thin are crowding or overlapping of tree crowns, closeness of trunks, and thin stems. Thinning releases the trees from excessive competition and stimulates greater growth, as well as removes those defective or malformed trees that will become a hazard in the future. Young tree stands should be thinned every 5-10 years until the stands reach mature form.

The first trees to thin are those in the high-risk category. These trees usually display abnormal color, poor retention of the oldest foliage, or slow growth. The second cut should be to the poorly formed trees: those that have double boles or oversized branches or that lean. The final cut, if necessary, should be done to space the trees so that the remaining branches do not overlap.

A spacing interval for trees at the Presidio can be calculated by adding 4 inches to the average tree diameter in inches (at breast height), and using the sum as the spacing of feet between trees in the thinned stand (e.g., an 8-inch-diameter tree should be spaced 12 feet from another, similarly sized tree). Appearance, sunlight access, and the intent to increase forest diversity should also be considered in spacing decisions.

Developing a Mature Forest

A final thinning should be done to achieve desired spacing or to remove potentially hazardous trees before they grow out of the sapling stage. When stands have been thinned and are growing vigorously, other shrubs and forbs can be introduced into the stands. Most of the maintenance done in the maturing stands involves fuel management and erosion control, as described in the following sections.

EROSION CONTROL

Erosion is a continuing problem at the Presidio, as described in Chapters 2 and 3. Human trampling of the forest floors and a tendency toward hydrophobicity in the forest soils result in the concentration of runoff, which creates gullies in the Presidio's sandy soils.

Regeneration cutting also involves soil disturbance, including loss of surface vegetation and litter, mixing of surface layers, and soil compaction. These disturbances also tend to increase runoff and, consequently, soil erosion. Because of the magnitude of potential problems, careful consideration should be given during the planning stage to evaluation of runoff effects of proposed reforestation activities. To minimize soil disturbance, alternative methods of logging and tree removal should be considered for steep slopes, such as helicopter, draft-animal, and cable systems.

In Appendix K, Table K-1 includes a list of erosion control measures recommended for each existing major erosion site and Figure K-1 shows the location of each site. Each control measure is described below. The first section below describes major control measures to be applied to a large number of sites, in order of their treatment priority. The second section covers control measures to be applied to only one or a limited number of specific sites.

Major Erosion Control Measures

Redirect Foot Traffic and Improve Footpath System

The existence of unplanned, unmaintained, yet heavily used footpaths in many areas of the Presidio is discussed in Chapter 3 as a primary cause of soil erosion and a factor in historic forest decline in some areas. The first control measure is to redirect foot traffic away from adversely affected areas. These routes should be closed off with signs, fences, and visual barriers that do not intrude on visual quality.

New trail routes should be selected and constructed as part of an overall integral trail network that is planned to be responsive to the existing use patterns. New and relocated trails should avoid or be constructed carefully on areas of Sirdrak sand. The Sirdrak series presents very difficult problems in trail stability and management, similar to experiences in any other park sand-dune area. All other soil types in the Presidio present good conditions for trails.

Trails on Sirdrak sand should follow contours and have as gradual a grade as possible. Crossing steep slopes, even on the contour, should be avoided. Where these routing location measures cannot be met or in heavy traffic areas, structural trail design measures must be implemented, including log or board walkways and stairways, rocking of pathways, or armoring with native Franciscan Formation fill or imported decomposed granite. Trails located on soil types other than Sirdrak sand can be constructed with standard trail design techniques.

As a part of trail abandonment, runoff should be redirected away from and off of eroding trails by grading diversions. Rock or woody debris may also be embedded in the retired trail beds to aid in stabilization. In some cases, restoration of trail areas may be accomplished as part of an overall restoration plan for the area, or as part of regeneration cutting for the historic forest. This need applies to large areas of historic forest degeneration as a result of widespread, heavy foot traffic (particularly at erosion sites 8 and 23).

Remove and Replace Trees Killed or Damaged by Erosion

On some erosion sites, soil loss around tree roots and exposure of tree roots are severe and have killed or damaged trees. Most occurrences are on Sirdrak soil, but some are on other soil types as well. Where root exposure is severe, the affected trees should be removed; removal of erosion-

affected trees is recommended at 13 sites. Some sites require the removal of only one or a few trees. Other sites (e.g., sites 8, 18, 20, 23, and 51) require the removal of several trees.

Tree removal should be done with as little disturbance to existing trees and groundcover as possible, especially those on Sirdrak soil. The preferred method is felling and bucking into small pieces for hand removal from the site with minimal vehicle traffic. Any ground or soil disturbance likely to channelize water and develop into gully erosion should be regraded. Groundcover must be reestablished; this may be accomplished by chipping woody debris and spreading it over the disturbed site. Root systems exposed by erosion should also be cut and removed, but roots and flush-cut stumps that remain beneath the soil surface should be retained.

Redirect Drainage and Construct Drainage Facilities

A cause of erosion on many sites is improperly designed or malfunctioning drainage facilities. In most cases, relatively minor and low-cost solutions are available to alleviate the drainage problems:

- Sites 7, 29, 32, 38, 41, and 45 are eroding pathways that require filling, outsloping, paving, and installation of drainage channels.
- Sites 16, 18, 19, 22, 35, and 43 are existing drainageways that require lining with gravel or rock to reduce downcutting, soil loss, and root exposure.
- Sites 22 and 33 have malfunctioning drainage systems that need to be redesigned and reconstructed.
- Sites 31, 32, and 50 need berms or diversion structures built to redirect the flow of drainage from the Inspiration Point parking lot and Julius Kahn Playground.
- Site 18 requires reconstruction of Lincoln Boulevard drainage by installing a berm to direct runoff away from the slopes to Baker Beach.
- Site 40 requires redirection and reconstruction of a drain on Park Boulevard that discharges into a large gully complex.
- Site 50 in the golf course may also require redirection of drainage.

In general, an important consideration is to avoid directing drainage from structures such as roads and parking lots to slopes on Sirdrak sand. The hydrophobic and unconsolidated sand is quick to form gullies where the flow of water is concentrated.

Repair Gullies

Several sites have small to moderate-size gullies that have formed as a result of concentration of drainage or runoff or as a result of unmanaged and unmaintained footpaths. Implementing corrective actions described under those measures will, in most cases, eliminate the cause of the gully erosion. Structural approaches to gully erosion control should not generally be undertaken.

In some cases, the gullies may slowly stabilize and revegetate after other actions are taken. The relatively small size of the Presidio may make it feasible to fill gullies with suitable soil material, stabilize the soil surface, and replant with appropriate historic forest or native restoration species.

Reduce Runoff Resulting from Hydrophobicity

Some gully erosion sites are characterized by high runoff from relatively small-slope areas of the sandy Sirdrak soil. This phenomenon may be the result of soil hydrophobicity resulting from growing conifers and eucalyptus. Field measurements have not been taken to confirm this apparent tendency, which would require a significant monitoring program. Development of such a testing program should be considered.

Two soil amendments to counteract hydrophobicity are feasible at the Presidio. The application and effects of these amendments should be tested as a part of forest removal operations.

Clay Amendment. The addition of a non-water-repellant clay to the sandy soil will help counteract hydrophobicity; it will also improve the soil by increasing soil aggregation, water-holding capacity, and soil fertility. Whereas trials in Australia have used sodic kaolinite or illite clay, montmorillonitic clay is recommended for its superior fertility and availability in California. The recommended application rate is 2.5-5.0 tons per hectare (Wallis and Horne 1992). Clay is not to be added to any soils scheduled for native vegetation restoration. Trial test areas at the Presidio should be established, monitored, and evaluated for 5 years.

Lime Amendment. Acidic pH is a factor contributing to hydrophobicity, and soils have apparently developed acidic pH in the historic eucalyptus and pine forest stands. The addition of lime to the soil sufficient to increase the pH to about 6.0 should help reduce hydrophobicity while maintaining an acidic soil pH suitable for conifers. Trial test areas for liming should also be established.

Tillage. After tree removal and the addition of clay or lime, tillage of the soil could be conducted to incorporate the soil amendment. In addition, tillage may help reduce hydrophobicity by mixing the topsoil with underlying, less hydrophobic layers and by the act of abrasion on water-repellant soil particles (Wallis and Horne 1992). Trial plots should be established for this practice also.

Stabilize Soil

After soil amendments are incorporated on steep slopes, or on wind-blown slopes above Baker Beach, the soil surface of Sirdrak soils may need to be stabilized.

Soil stabilization in the most critical areas may require a straw mulch held in place with suitable erosion control blankets or netting and staples. Straw blankets may also be used. Native grassland hay may be used in areas where native grassland restoration is desired. Straw mulch should be applied at the rate of 2 tons per acre. Good soil contact must be achieved with the straw and netting. Staples may need to be as long as 2 feet to ensure stability on the sandy soil. Nitrogen fertilizer should be added to the soil (along with any clay or lime applied) to prevent nitrogen deficiency during mulch decomposition. Tree planting should be performed simultaneously with soil stabilization to reduce the need for site reentry and additional soil disturbance.

In less critical and more accessible erosion control areas, punched straw or suitable erosion control blankets or netting alone may be used for soil stabilization. In areas without steep slopes, wood chips from tree removal should be applied as a mulch and an armoring surface.

Restore Native Vegetation

The removal of the nonhistoric forest for natural ecosystem restoration will increase the risk of erosion until native vegetation becomes well established.

In addition to removing trees, the litter layer that has accumulated under undisturbed forest should also be removed to allow for soil amendments and restoration planting (Appendix H). The litter layer should be removed by either burning or raking. The resulting bare soil will be highly prone to erosion, including both the hydrophobically altered Sirdrak sand and other soils on moderate to steep slopes (principally the Cronkhite, Barnabe, Kron, and Henneke soil series of the Franciscan Formation) (Figure 3-1).

Native grass seeding can be applied only in those areas restored to serpentine grassland. Other restoration types (dune scrub, coastal scrub, oak woodland, and serpentine bluff scrub and chaparral) will not have a uniform grass cover, and the establishment of the nongrass native plants as an erosion control measure will take longer than grass seeding.

The success of the native plant restoration effort will depend on stabilization of the soil surface. An application of suitable erosion control blankets or netting (described above) and a straw mulch as groundcover (described below) should be used to provide erosion protection while allowing for native plant establishment (Appendix H).

Maintain Groundcover

A continuous groundcover must be maintained under the historic forest. The groundcover aids in increased organic matter input, retention of soil moisture, reduced runoff and increased water infiltration, and reduction in mechanical soil disturbance such as from foot traffic. The latter two factors are especially critical to counteract apparent hydrophobic soil conditions on the Sirdrak soil.

The first approach in groundcover maintenance is the preservation of the existing groundcover. The primary cause of groundcover loss is disturbance from foot traffic. A network of stable footpaths should be constructed throughout the Presidio forest, and informal paths should be abandoned, as described previously.

When conducting tree removal for historic forest, particularly on Sirdrak soil, reapplying a groundcover in disturbed areas is important. Branches and, in some cases, boles from forest removal should be chipped and distributed onsite to provide new groundcover. Chipping provides small-size groundcover material, which is important for ensuring good soil coverage and contact.

On areas designated for restoration of native plant communities after historic forest removal, the recommended groundcover is straw. Straw is an effective groundcover that is compatible with natural vegetation communities such as coastal terrace prairie and northern coastal scrub.

Secondary Erosion Control Measures

Remove Fill

On a few erosion sites, the removal of artificial fill will facilitate the implementation of erosion control measures and the restoration of native vegetation. The removal of a large area of fill at site 1 will facilitate the restoration of native serpentine vegetation and limit future erosion. The removal of remaining large pieces of a concrete pad from site 14 will simplify placement of a bioengineered retaining wall, enhancing both erosion control and restoration of native vegetation. The removal of fill from a large staging area at site 42 and restoration to either historic eucalyptus forest or native riparian vegetation will facilitate erosion control.

Regrade Site

On sites 8 and 10, the erosion is so severe that large fans of displaced sandy sediment have accumulated downslope of large gully networks. Regrading and recontouring of the gullies and replacement of the displaced sediment onto the eroded slopes, before other erosion control measures are implemented, will facilitate site recovery.

Add New Fill

Where deep gullies have formed and material cannot be recovered from downslope deposits, gullies should be filled with imported fill after the causes of the gully erosion have been remedied. Three sites in particular that will benefit from addition of new fill are sites 12, 33, and 41; new fill already has been added to site 12 as part of previous erosion control efforts.

Construct Retaining Walls

New retaining walls should be constructed to stabilize and restore the slope on the south bank of the mouth of Lobos Creek (site 14) and provide protection to the houses upslope. The recommended design is a stepped series of bioengineered cribwalls with willows used as the plant material (U.S. Soil Conservation Service 1992). A bioengineered cribwall will provide the necessary slope stability and the appearance of a naturally vegetated slope and streambank. If desired, a constructed walkway could be built in conjunction with the cribwalls to provide pedestrian access from 25th Avenue to Baker Beach.

Construct Boardwalk

The routing of footpaths on old sand dunes and vegetated foredunes is problematic because of the unstable nature of the sand. An armored and paved walkway leading from Lincoln Boulevard to Baker Beach (site 25) has failed. This walkway needs to be replaced with an elevated boardwalk or a log walkway similar to that along the lower portion of the route. An elevated boardwalk traversing the vegetated foredunes leading to Baker Beach (site 15) would also help reduce destabilization of the vegetated foredunes bordering the pathways.

Pave Footpath

The shallow, gullied footpath of compacted sand at site 7 would benefit from reshaping and sloping, paving, and construction of a paved or armored drainage channel. The gullied footpath at site 41 would also benefit from the same treatment.

Replenish Sand

Replenishment of sand displaced from the footpaths, in conjunction with construction of a boardwalk, will aid in the stabilization of the vegetated foredunes at site 15.

Install Railing

The existing railing on both sides of the log walkway descending the sand dune slope to Baker Beach (site 25) is offset several feet to the side of the log walkway. Hikers prefer the easier walking on the sand to that on the logs. As a result, downslope movement of the sand is defeating the purpose of the walkway. The railings need to be reinstalled directly adjacent to the log walkway.

Erosion Control Maintenance and Monitoring

Maintenance and monitoring are essential components of any successful erosion control program. All new erosion control measures or structures should be inspected during and after the first heavy rains of the season following installation. Any maintenance or redesign indicated by initial performance should be undertaken as soon as possible.

A program of periodic inspection of new erosion control measures and monitoring of highly erodible and high-use areas of the Presidio should be established. Monitoring is essential for all historic forest restoration on Sirdrak sand and for all native vegetation restoration sites.

Sediment Protection Zones

Three hydrologic features are present at the Presidio: Lobos Creek, Mountain Lake, and El Polin Spring. Lobos Creek is the only free-flowing creek remaining in San Francisco and is the domestic water source for the Presidio. All three features have been altered from their prehistoric condition, yet they still support functioning ecosystems and are important parts of the park's remaining natural areas. The protection and restoration of these hydrologic features is an important element of NPS management of the Presidio.

Lobos Creek

The Lobos Creek watershed within the Presidio extends from the Pacific Ocean on the west to the parking lot of the former Public Health Service Hospital on the east, and from the Wherry Housing area on the north to the private residences lining the upper south-bank slope north of Lake Street and east of 25th Avenue. At one time, a direct hydrologic connection may have existed from Mountain Lake to Lobos Creek, but none exists currently. Aquifers sustaining Lobos Creek are thought to extend southward from the Presidio under a large area of northwestern San Francisco.

Sediment and other pollution can enter the stream system at three key locations. The first location is the Lincoln Boulevard bridge crossing and vicinity. The second location is the Public Health Service Hospital and parking lot. The third source is the private residences and streets lining

the south slope of the watershed. Contributions from these sources should be monitored and remedial action taken, if needed, in cooperation with the City of San Francisco's Clean Water Program.

Forest management cutting and reforestation projects probably would not adversely affect water quality of Lobos Creek because of the locations of most stands. Regeneration of the historic forest in the watershed north of the stream should be accompanied by thorough implementation of the erosion control measures described above for Sirdrak sands.

Mountain Lake

The watershed of Mountain Lake is primarily the Presidio Golf Course, which covers the watershed slopes to the north and east. A drainage channel and natural creek flow along the southern Presidio boundary from the east directly into Mountain Lake. The south side of the Mountain Lake watershed comprises the City of San Francisco's Mountain Lake Park and private residences along the south side of West Pacific Avenue. Drainage into the lake from the west is controlled by the adjoining Park Presidio Boulevard and Highway 1. Highway 1 was constructed by filling in a portion of the west side of Mountain Lake.

There are two principal areas of possible pollutant input into Mountain Lake. The golf course contributes dissolved fertilizers and, on occasion, pesticides. Highway 1 presents the potential for roadway pollutant discharges.

A source of sediment input into the lake at present is erosion site 10; it should be remediated.

Forest management activities have the potential to degrade the lake's water quality, especially cutting in the stand along the tributary creek noted. The recommendation for this eucalyptus stand (E201) is the nonintensive management option, and the stand is suited to coppicing of mature hazardous or senescent trees. Bole removal should be done very carefully so as not to damage understory vegetation along the stream channel.

El Polin Spring and Drainage

El Polin Spring is located downslope of Inspiration Point, an old quarry site, and Quarry Road. Erosion site 12, drainage from Quarry Road that formed a gully upslope and toward El Polin Spring, has almost affected the spring directly. The road drainage has now been redirected and the gully partially repaired by refilling.

The greatest surface impact on El Polin Spring comes from foot traffic trampling directly around the spring, removing vegetation and compacting the soil.

The spring water flows north through housing areas toward the former marsh to be possibly restored at Crissy Field. That restoration project is not described in this plan, but tree removal to increase sunlight to the restored riparian zone will be needed to accommodate it. Tree removal and other forest management near El Polin Spring and the creek draining from it should be done carefully so that boles and large branches do not damage the aquatic or riparian habitats.

FIRE PROTECTION

The concern for fire within the Presidio forest has had a major influence on past vegetation management practices. Practices used by the U.S. Army prevented serious losses from wildfire, and in general that approach to fire protection should be continued. Prevention, suppression, and rehabilitation are the three major aspects of fire protection services.

Prevention

For both forest fire and structural fire protection, the most important stage is prevention, which begins with an understanding of fire history and present fire potential.

Fire History

Fire probably was used on the Presidio by the Spanish as a land-clearing tool and to clear brush from valuable pasturelands. The wildfires that occurred before the Presidio forest was planted were probably fast-moving grass and brush fires of light intensity. Studies in similar habitats of coastal Marin County found that before the 1900s, major fires occurred on an average of every 7 years (Cole pers. comm.). Natives or early settlers may have had an influence on this frequency.

Once the forest was established, the danger of wildland fires was probably reduced. The grass and brush fields were broken up with fairly fire-resistant vegetation. The young trees shaded out most grasses and deposited very little burnable (dead) woody debris to fuel a fire.

The resistance of the forest to fire has changed as it has grown older. The amount of fuel on the ground has increased, and in some stands where little fuel modification has been done, the threat of fire is increasing. Increasing use under NPS management will continue to increase visitation, potentially increasing the frequency of fire starts.

Fire Potential

Forest fire potential at the Presidio is determined by weather, topography, and the type and age of the vegetation.

Weather. The climate at the Presidio and in San Francisco generally is cooler and wetter than in neighboring inland areas. During the summer, fog drip and shadow greatly increase humidity and reduce the potential for wildfire start and the possible rate of spread. However, for about 10 days during late summer or fall, easterly winds blow from a warm, dry continental air mass. These winds dry the usually moist forest fuels, resulting in a high fire danger.

Topography. A forest fire generally burns hottest and most rapidly upslope or in the direction of the wind. Natural topographic constrictions, such as saddles at the head of canyons, are especially fire prone because of the funneling of winds. Fires may expand when spot fires ignite ahead of the main fire. In steep and narrow draws, radiating heat may also be a major factor in fire spread.

Vegetation. Forest vegetation has a great influence on the severity of fire hazard. Three aspects of vegetation character affect this hazard:

- Fuel Ladder Structure - Fire usually starts on or near the ground. If it can climb a ladder of fuel to the canopy, a destructive and dangerous fire can result.

- Fuel Loading - As trees in a forest grow taller, they shed their shaded lower branches. Over time, a large amount of fuel can accumulate under the forest canopy.

- Species - The eucalyptus stands, because of their high natural loading of fuels and high oil content, can contribute to explosive, major fires.

The U.S. Army addressed these hazards by an intensive treatment of ground fuels in stands nearest to major developed areas. Under certain stands, coarse fuels were removed and finer fuels were treated by pruning trees and mowing understory grasses to suppress brush, seedlings, and weeds. In other areas, little or no treatment of ground fuels has occurred.

Under this vegetation management plan, these practices should generally continue. Specific stands are recommended either for intensive management and replacement or for nonintensive management that will continue to allow more natural regeneration and fuel loading on the forest floor. However, under the latter option, pruning of fuel ladders on a periodic basis should be increased.

Reducing Structure Flammability

The primary concern of wildland fire protection at the Presidio is structural protection. The fire safety of a building depends on the continuity and loading of the fuels around it, the location of the building with respect to topography, and the design of the structure itself. Building density is also an important consideration because a burning structure can ignite adjacent structures.

Roofs. The roof is the most vulnerable part of a structure because it is exposed to airborne sparks. The wood shingle roof has been the most important element in structural losses during wildland fires. It is also a major source of airborne firebrands capable of igniting nearby structures. Such roofs should not be used at the Presidio near forest stands.

Siding. Changes to Presidio building materials are subject to Section 106 compliance. If compatible, exterior materials used on structures near forest stands should have a fire-resistance rating of at least 1 hour. This is especially critical for parts of structures exposed to winds or positioned at the top of a slope. Fortunately, many of the Presidio buildings adjacent to forested areas are constructed of brick.

Hazard Reduction through Vegetation Maintenance around Structures

Landscape maintenance is the best way to keep structures separated from surrounding vegetative fuels. The objective is to keep the configuration and amount of fuels at a safe level and to create a safety zone for residents, firefighters, and fire equipment.

For forest fire prevention purposes, the area around a structure should be divided into three zones of defense:

- near zone (0-30 feet) - year-round maintenance;
- mid-zone (30-100 feet) - seasonal maintenance;
- far zone (100 feet or more) - yearly inspection, with maintenance if warranted.

Near Zone. Outside of the Presidio, California Resources Code Section 4219 requires clearance of flammable vegetation for a minimum distance of 30-100 feet around any structure located in a fire hazard area. The clearance distance is subject to local ordinance, and fire authorities may require clearance beyond 100 feet.

The area within 30 feet of the structure is most critical for fire safety. Maintenance of nonflammable landscaping, such as lawns, border plantings, flower gardens, and vegetable beds, should be used to reduce fire hazard close to structures. Additionally, all leaves should be removed from roofs before the fire season begins.

Mid-Zone. Seasonal fire maintenance in the 30- to 100-foot zone around a structure should consist of removing dead woody plants and occasionally pruning trees and shrubs.

Far Zone. The amount and continuity of vegetation should be inspected and altered if necessary.

Suppression

When a fire occurs in the forest, appropriate tools and equipment, as well as trained personnel, should be available to suppress it.

Suppression of a wildland fire and suppression of a structural fire are fundamentally different. Suppression priorities are based on the value of property to be protected. A forest fire should usually be attacked only after the structures it is threatening are adequately protected.

All fire departments have cooperative agreements with adjacent fire departments to handle a serious structural conflagration. The Presidio fire department should continue to enter into such agreements with the City of San Francisco. It should also enter into agreements with wildland fire suppression agencies, including Marin County fire departments, the East Bay Regional Park District, and the California Department of Forestry and Fire Protection. Agreements should involve training, equipment sharing, and suppression assistance.

Rehabilitation after Fire

Once a fire has removed the vegetative cover, erosion should be expected to occur the following winter. Measures described in the foregoing "Erosion Control" section, such as mulching, grass seeding, hay punching, and netting, should be used as needed.

Fire is a natural way to encourage reproduction of two of the most widespread tree species on the Presidio, Monterey pine and Monterey cypress. Unfortunately, the first plants to occupy burned sites are usually undesirable weed species such as scotch broom. Moreover, experience with forest fires on Angel Island has shown that after a fire in eucalyptus stands, sprouting can result in an even more serious fire hazard within 3 years. Other tree species and certain grassland and brushland communities exhibit similar behavior. Accordingly, rehabilitation after each serious wildland fire should be carefully planned to ensure the recovery of desirable vegetation.

WOODY DEBRIS DISPOSAL

Most woody material, which includes tree branches, limbs, and trunks, should be chipped and spread at forest restoration sites. Boles too large or valuable to chip should be moved to a central location on the Presidio.

Planned Increase in Woody Debris

Woody debris has been increasing at the Presidio as trees become overmature and fail. Volumes of woody debris will substantially increase with implementation of the tree removal program described in this plan. Chapter 7 describes a possible recovery and use plan for this material. Practical aspects of moving and chipping this material are described below.

Use of Small Debris

Small woody debris consists of maintenance prunings, large branches from tree removal activities, or bole material from trees removed piece by piece. Manual labor is needed to move small woody debris to chippers or transporters. If equipment can be brought close to trees, debris handling costs will be reduced, although such access should be limited by erosion control needs. If the material is chipped in small, portable chippers and distributed or stockpiled onsite, costs will be minimized. A whole-tree chipping operation could also be instituted, although this requires larger, more powerful chippers. The Presidio forest, because of its unique location and age, calls for use of state-of-the-art chipping and distribution technology.

Removal of Large Debris

Unchipped tree boles should be removed to a central log storage yard using a large, heavy-duty skidder, a winch truck, or a small farm four-wheel-drive tractor. The winch should be used in conjunction with the skidder or winch truck to move the logs to roadside loading areas. A small farm tractor does not have the pulling or winching power of a skidder but, with additional labor, can move the tree in smaller pieces using the bucket loader.

Large logs require specialized equipment, such as front-end loaders, to load them into heavy-duty dump trucks, log trucks, or flatbed trucks and transport them to a storage yard where they can be sorted, reduced, and disposed of. Front-end loaders and tracked equipment should not be used to move logs appreciable distances. A description of equipment recommended for moving large woody debris offsite is given in Appendix M.

CULTURAL RESOURCE PROTECTION

Many of the vegetation management actions described in this plan are intended to restore key aspects of the Presidio's historic planted forests. The special treatment of historic forest stands and

entryway plantings at the Presidio is intended to preserve these historic resources as long as possible and then to regenerate them as replicates. Historic resources are thus enhanced by implementation of this plan.

If subsurface historic artifacts are discovered or suspected in a management plan area, all activities that could threaten them should be suspended. NPS archaeologists will assess the resources and will propose avoidance or monitoring of digging activities as outlined in the Presidio Programmatic Agreement signed by the California Office of Historic Preservation, the Advisory Council on Historic Preservation, and NPS.

Chapter 7. Recovery and Use of Wood Resources

INTRODUCTION

Costs to harvest and market forest products resulting from forest management activities on the Presidio were estimated in the 1990 forest management plan prepared for the U.S. Army (Jones & Stokes Associates 1990a). The cost and recovery estimates given in this chapter were obtained from that plan and may not reflect current conditions; however, they give an indication of the cost of implementing this plan.

RECENT TREE REMOVAL AND WOOD USE

Tree removal at the Presidio has been restricted to hazardous trees, trees that have fallen during storms, and dead or dying standing trees. Before the Presidio was acquired by NPS, removal work was performed by the 19 U.S. Army employees of the base grounds maintenance staff and tree removal contractors. Nearly all trees removed from the Presidio were hauled in log form to a central storage yard covering approximately 1 acre in the Fort Scott area. Logs were deposited there into debris boxes owned by a private vendor who periodically removed full boxes and replaced them with empty ones.

Portable wood chippers were occasionally rented for in-woods use on the base. The resulting chips were usually distributed onsite for landscaping or erosion control purposes. The Presidio did not stockpile chips for onsite use; pine bark chips were purchased for mulching and other landscaping uses (Straub pers. comm.).

A timber sale agreement between the U.S. Army and an independent logger/firewood operator was entered into following adoption of the 1984 forest management plan (McBride 1984). For most of the approximately 18 months during which this agreement was in effect, the contractor cut trees from the Presidio into firewood that was subsequently marketed off base. Until the default of the agreement, the contractor hauled logs to a biomass energy generation facility in Antioch, California, where they were ground into fuel and burned.

PROJECTED TREE REMOVAL

Harvesting Systems and Techniques

All trees to be removed on the Presidio would probably be felled with chainsaws. Use of mechanized harvesting equipment, such as feller-bunchers, is probably inappropriate on the Presidio because of the small size of proposed harvest areas. Where the harvesting of trees is not complicated by adjacent structures, roads, utility lines, or other trees, trees can simply be cut near the ground as in conventional commercial logging. For trees of average size for the Presidio (18 inches in diameter at breast height), a skilled logger can expect to fell, buck into sections, and limb up to 25 trees per day (Howard pers. comm.). This production rate corresponds to an average cost of approximately $20 per tree based on 1989 rates and applies only to some portions of the areas designated for group- selection harvesting. Because of the hazards imposed by adjacent trees, the first trees harvested in each group selection area should be topped before being cut down.

Special harvesting techniques should be used wherever nearby structures or property could be damaged by falling trees, or where falling trees could become entangled in adjacent trees. In most urban settings, trees must be topped before they are felled. The faller must climb the tree or access it with a motorized, hydraulically operated bucket; attach lines to its top; and then cut and gradually lower the top. In many cases, the entire tree must be cut and lowered in sections. Such careful work usually requires a crew of three and is particularly dangerous, especially for the faller. Felling costs using these techniques have ranged from approximately $320 per tree for a simple topping to more than $1,000 per tree for a difficult, multiple-section felling task in the late 1980s (Howard and Lyons pers. comms.). Costs in this range would apply to removal of most hazard trees and some trees in historic or screening stands.

Wood Collection and Processing

In-woods processing consists, at a minimum, of removing tree limbs and unusable tops. This material should be chipped onsite with a portable chipper and distributed nearby for erosion control and mulching of seedlings in areas to be reforested. In some cases, entire stems can be skidded or winched out of the forest and loaded onto trucks. In other cases where moving long logs is likely to result in damaging collisions with standing trees, logs should be bucked into sections before being moved. If logs are to be used for pulp chips, they should not be skidded but carried out of stands with specialized log transporters.

Once out of the forest stands, logs are loaded onto trucks for hauling either to a centralized storage yard on the Presidio or directly to a wood processing plant. Assuming equipment costs of $60 per hour for the skidder, loader, and truck; labor costs of $90 per hour for a three-person

crew; and a production rate of 12 trees per hour, average total costs of skidding, loading, and hauling to a yard on the Presidio were estimated at approximately $12 per tree in 1990.

WOOD USE

Market Uses

Wood removed from the Presidio could be processed into four market products: sawlogs, pulp chips, firewood, and energy fuel.

Sawlogs

The Monterey cypress stands on the Presidio contain some of the tallest and straightest trees of this species found anywhere. These qualities make the Presidio's cypress trees particularly desirable as sawlogs and peeler logs for use as lumber and veneer, respectively. Although Monterey cypress is not widely used in the lumber industry in California, it has been marketed as a specialty wood because of its light color and other attractive characteristics (Staub pers. comm.).

In the 1980s, several small sawmills in coastal California expressed interest in purchasing cypress logs from the Presidio (Blevins, Murphy, and Staub pers. comms.). In contrast, none of the large sawmills contacted expressed such interest (Stone and Taylor pers. comms.). In 1989, one mill was paying $200 per thousand board feet (MBF) for Douglas-fir logs, which the purchaser considered to be similar in value to Monterey cypress (Blevins pers. comm.).

Constraints that could limit the feasibility of marketing sawlogs from the Presidio include the need to sell a sufficient volume of logs to make lumber marketing cost effective and the presence of rot and other defects in the cypress trees. To make sawlog sales commercially feasible, at least 100 MBF would need to be offered for sale at a time (Staub pers. comm.). The most common source of defects in Monterey cypress is brown cubical rot, which affects stems and branches (Herman Zillgens Associates 1988).

Other species available for harvesting from the Presidio in large volumes (i.e., blue gum eucalyptus and Monterey pine) are apparently not in demand for lumber or veneer production.

Pulp Wood

Wood from the Presidio could be used in the manufacture of wood pulp. Pulping requires the use of high-quality chips (i.e., chips of uniform size; free of rot, dirt, and other contaminants; and with bark content no greater than 0.5%) (Burk pers. comm.). In-woods chippers are frequently incapable of producing chips that meet these standards. Pulp chip production at the Presidio would probably involve collecting bucked logs that have not been skidded; hauling logs to a storage yard; chipping them there using a large, stationary chipper designed for pulp chipping; loading chips into large vans; and shipping the chips to either a pulp mill or a shipment yard.

Potential pulp chip markets for wood from the Presidio are Gaylord Container Corporation in Antioch and two wood-product export firms at the Port of Sacramento. Of the tree species expected to yield commercially significant volumes of wood from the post, interest in the pulp chip market focuses primarily on blue gum eucalyptus. Because of the continuous expansion of worldwide paper products consumption and the highly desirable pulping characteristics of eucalyptus, demand for eucalyptus pulp increased rapidly in the 1980s and was expected to continue to do so (Slinn 1987). Local demand for eucalyptus chips fluctuates, however, subject to short-term changes in orders, production rates, and chip supplies. Eucalyptus pulp chips delivered to Antioch in 1990 sold for approximately $65 per bone-dry unit (BDU) (one BDU equals 2,400 bone-dry pounds or 1.2 bone-dry tons) (Morgan pers. comm.).

Monterey pine chips also have the potential to supply pulp markets. Pine chips of pulping quality sold in 1989 at the Port of Sacramento for approximately $22.50 per green ton (Burk pers. comm.). This green wood price corresponds to a price of $54-$68 per BDU, depending on average wood moisture content. The value of pulpwood chips has remained high in 1995.

Firewood

The U.S. Army managers of the Presidio administered wood sales for firewood production. The contract to remove fallen or high-hazard trees and process them into firewood encountered significant problems that culminated in default of the contract (Straub pers. comm.). These problems included the disruption of normal Presidio activities because of onsite firewood processing, the relatively low popularity of firewood from the tree species available on the Presidio, and the need to market firewood in small units in the San Francisco area.

In the 1980s, firewood sold for as much as $200 per cord in San Francisco. Most firewood consumed there is purchased in smaller units, however. Boxed wood has sold at most supermarkets in 1-cubic-foot units for approximately $5, and in 1.5-cubic-foot units for approximately $6, corresponding to a price range of $320-400 per cord. Storing more than a few cubic feet of firewood would be a problem in many San Francisco households.

Firewood from native oaks is considered most desirable by most users; eucalyptus wood, however, is comparable to oak in heat content. A substantial impediment to marketing is purchasers' unfamiliarity with eucalyptus as firewood. Softwoods such as pine and cypress produce less heat per unit than hardwoods such as oak or eucalyptus, and consequently cost less per cord.

After logs have been hauled to a storage yard, they need to be bucked and split into pieces of convenient size for home use. Bucking, splitting, and stacking have been estimated to cost approximately $25 per cord (Reynolds pers. comm.). After processing, firewood is usually seasoned for 3-6 months. Seasoned firewood could be marketed at the storage yard, at another location on the Presidio, or at firewood lots elsewhere in the Bay Area.

Access to efficient marketing channels is essential for profitable firewood sales, as evidenced by the default of the recent Presidio firewood contract and by the low prices paid to the City of San Francisco by local firewood operators for wood delivered to the storage yard at Golden Gate Park. The most any operator agreed to pay the city for delivered logs was approximately $3 per cord in the late 1980s (Smith, Stephen pers. comm.). Considering the high retail prices for firewood in San Francisco and the low transport costs associated with a local wood supply, however, firewood sales from the Presidio could become a significant source of revenue. Finding contractors with the skill and care needed to produce wood without unduly disturbing the Presidio's environment, residents, visitors, or neighbors, and who would be able to harvest, process, and market firewood efficiently, is expected to be difficult (Nicoles pers. comm.).

Fuel Wood

In the 1980s, wood increased in demand as fuel for generating electricity. More than 420 megawatts of electrical capacity operating on biomass fuels were installed in California between 1975 and 1990 (Magaletti pers. comm.). Wood residues from sawmills and other wood-processing facilities were traditionally the least expensive source of wood for power plants, but because of expanded cogeneration and market electricity sales by wood processors, sawmill residues became increasingly scarce. As a result, marketing of forest resources for biomass fuels became more feasible.

Logs are usually ground, rather than chipped, into fuel. Fuel wood standards are lower than those for pulp chips; both portable chippers and stationary chipper/grinders produce fuel suitable for burning in biomass plants. In 1989, Gaylord Container Corporation paid approximately $23 per BDT for wood fuel delivered to Antioch (Morgan pers. comm.). Prices for fuel wood may increase in the Sacramento area if new wood-burning power plants come on line (Burk pers. comm.). In 1995, however, the value of fuelwood chips remained relatively low.

Erosion Control and Landscaping Uses

The Presidio has a large capacity for using wood chips in erosion control and landscaping projects. Using wood chips for erosion control and landscaping reduces soil erosion, conserves irrigation water, inhibits weed competition, increases the success of tree planting, and improves the appearance of cutting sites. Using chips from trees growing on the park would reduce costs relative to the recent practices of buying similar materials for landscaping uses and paying a private refuse company to dispose of waste wood. Chips should *not* be applied to native vegetation restoration sites.

Two approaches are available for using wood chips produced on the Presidio for landscaping. The first approach involves chipping and distributing wood at the logging site. This approach could be implemented in conjunction with a wood marketing program whereby the main stems of harvested trees are removed for marketing and the unusable tops and branches are chipped and used for site enhancement. If the tree's stem is unusable, for example, because of its species or because of defects, the entire tree could be chipped and distributed onsite. Chips can be used as groundcover to stabilize areas of exposed or disturbed soil and can be placed around seedlings to reduce evaporation from soil surrounding the plant's roots.

The second approach involves hauling logs from harvest sites to a storage yard, chipping the logs and storing the chips at the yard, and then transporting the chips to areas where and when they are needed. This approach is substantially more costly than the first approach, but it provides chips for landscaping use at areas other than active logging sites.

Assuming a crew of two to operate a portable chipper at a total cost for labor, machinery, and fuel of $55 per hour, in-woods chipping and distribution were estimated in 1990 to cost the equivalent of $30 per BDT, exclusive of tree felling costs. Under the second approach, skidding and hauling logs to the storage yard and chipping them there using a stationary chipper were expected to cost approximately $27 per BDT; redistributing those chips would cost an additional $50 per BDT, for a total cost of $77 per BDT. Onsite use of chips thus represented a savings of $47 per BDT relative to an approach involving centralized collection and redistribution.

To compare the value of chips at the storage yard for landscaping use versus market use, consider that in 1990 the chips would receive a minimum price of $23 per BDT (the fuel wood price), less a round-trip hauling cost of approximately $11 from the Presidio to Antioch, for a net market value of $12 per BDT at the storage yard. Marketing chips would thus result in a net savings of at least $62 per BDT, primarily by avoiding the $50-per-BDT cost of redistributing chips. This analysis, however, does not consider the substantial erosion control and landscaping benefits that chips can provide.

Chapter 8. Citations

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Appendix A. List of Preparers

List of Preparers

This plan was prepared primarily by Jones & Stokes Associates of Sacramento, California under the direction of Jones & Jones of Seattle, Washington, according to a contract issued by the National Park Service's (NPS's) Denver Service Center. Other subcontractor firms assisted in specific areas, including:

- Britton Tree Services, St. Helena, California (hazard trees);
- Dr. John Harris, Oakland, California (mammals);
- Dr. John Hafernik, San Francisco, California (arthropods); and
- Dr. Elizabeth Pierson, Berkeley, California (bats).

Jones & Stokes Associates' project manager was Ken Casaday, a natural resource management planner. He was assisted principally by Bruce Boyd (project coordinator, computer-aided design/geographic information systems manager, and forestry technician), Dr. Edward Beedy (wildlife biology), Dr. Paul Cylinder (plant ecology), Wayne Verrill (soils), Nick Dennis (forester and forest economist), and Sheri Brown (restoration ecologist). Portions of the plan were adapted from the forest management plan prepared for the U.S. Army (cited in the main report as Jones & Stokes Associates 1990a) by Jones & Stokes Associates and Stephen G. Smith, consulting forester. This document has been produced by Debra Lilly, publications specialist; Charla McCollum, word processing operator; Tony Rypich, graphic artist; and Bev Fish, report reproduction specialist.

Jones & Jones' project manager was Keith Larson (principal). NPS's Contracting Officer's Representatives were Terri Thomas (ecologist) and Nicholas Weeks, and NPS's Contracting Officer's Technical Representative was Brian Mattos (forester). Several other staff members of NPS's Golden Gate National Recreation Area also provided technical direction and review, notably Daphne Hatch (wildlife biology), Laura Nelson (botany), Sharon Farrell (botany), Ric Borjes (historical architecture), and Steve Haller (historian).

Appendix B. Tree Hazard Assessment and Hazard Tree Management Plan

Tree Hazard Assessment and Hazard Tree Management Plan

This appendix has been prepared by Britton Tree Services. The text of the assessment and plan, including Appendix 4, is reproduced here. Appendixes 1, 2, 3, 5, and 6 are on file with Golden Gate National Recreation Area staff. Figure 3-9 in Chapter 3 of the forest plan shows the locations of hazard trees identified to date.

PRESIDIO OF SAN FRANCISCO
FOREST MANAGEMENT PLAN
1995

HAZARD TREE INVENTORY
1994 - 1995

PREPARED FOR:

NATIONAL PARK SERVICE
Under Contract With:
JONES AND JONES
Seattle, WA

PREPARED BY:

DENICE F. BRITTON
JOHN C. BRITTON
CONSULTING ARBORISTS

BRITTON
TREE SERVICES, INC.

P.O. BOX 424
ST. HELENA, CA 94574
(707) 963-7578
(707) 963-7599 FAX

APPENDIX B

PRESIDIO OF SAN FRANCISCO
FOREST MANAGEMENT PLAN

DRAFT
TREE HAZARD ASSESSMENT
AND
HAZARD TREE MANAGEMENT PLAN

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ATTACHED AS A SEPARATE DOCUMENT:

APPENDIX 5 - PHOTOGRAPHS OF TREES IN HISTORIC LANDSCAPE SETTINGS RECOMMENDED TO BE TAKEN DOWN

APPENDIX 6 - MAPS OF HAZARD TREES

INTRODUCTION AND SCOPE OF WORK

The intent of the Hazard Tree Assessment is to identify all trees in high to moderate use areas that may pose potential hazards to people and property within the Park boundaries and to develop a management plan for reducing or alleviating these hazards.

There are some 7,000 to 8,000 trees growing around homes, office and warehouse buildings or along roads that have the potential for causing damage to people, vehicles or buildings. This first phase of this project was to analyze 1100 trees around the most highly used areas.

A previous Hazard Tree Assessment survey was completed in March of 1988 by Hermann Zillgens Associates of San Diego, California. During this survey, trees were tagged and numbered near all high to low use areas and adjacent to roads, parking areas and major streets. Forest areas were specifically excluded from the assessment. The US Army subsequently contracted to have the most hazardous situations alleviated. This work was performed and completed in 1994. (See the Discussion section of this report for further information on this work.)

METHODS

The Park Service obtained the original database from the 1988 *Identification of Hazardous Trees* on disk. Since the Park Service has been using this database and is familiar with the location of trees as described in that system, we decided to utilize the numbering and mapping system already in place. This allows the Park Service to maintain a more complete record of each tree, and its condition prior to their possession of the Presidio.

The contracted work included evaluating trees in the high use areas. Trees around homesites and in other high use areas were inspected, and evaluated for defects that might lead to failure. Trees noted as being in poor enough condition to be considered a hazard tree were documented in the database. Those trees recommended for removal were photographed for historical reference.

The hazard assessment was performed using the techniques outlined in the Park Service documents entitled *Western Region Directive #WR-093 and 1993 Guidelines for Managing Hazardous Trees.* The method provides for 2 areas of rating the trees; by the intensity of land use and the seriousness of the defects observed in the tree. Additionally, the draft *Standard Operating Procedures of the Golden Gate National Recreation Area for Vegetation Cutting and Removal* were used to guide our decision on which trees to include in the database.

Description of Database Entries

The details of how the rating system was used in this particular inventory are described below. A field data sheet is included in the beginning of each appendix listing trees.

Tree #:

Each tree was given a number and tagged with that number. The number either corresponded to the previous survey number, as indicated on the maps provided or found on the tree's tag. Any tree with an existing number that did not have a tag was re-tagged with an aluminum racetrack-shaped tag attached with an aluminum nail. Any tree that had not previously been tagged or mapped was provided a new number, beginning with 8001. These trees were also tagged and mapped.

Tree Species:

The database contains the common name of each tree identified as potentially hazardous. The common name corresponds with the following scientific names:

Avocado	*Persea americana*
Bailey acacia	*Acacia baileyana*
Black acacia	*Acacia melanoxylon*
Black walnut	*Juglans hindsii*
Blue gum	*Eucalyptus globulus*
Pink Ironbark	*Eucalyptus sideroxylon*
Red Flowering Gum	*Eucalyptus ficifolia*
River Red Gum	*Eucalyptus camaldulensis*
Eucalyptus species	*Eucalyptus sp.*
Bottlebrush	*Callistemon rigidus*
Brush Cherry	*Syzigium paniculatum*
California pepper	*Schinus molle*
Canary Island Date Palm	*Phoenix canariensis*
Chinese elm	*Ulmus parvifolia*
Coast Live oak	*Quercus agrifolia*
English oak	*Quercus robur*
Coast Redwood	*Sequoia sempervirens*
Corkscrew willow	*Salix matsudana* 'Tortuosa'
Cryptomeria	*Cryptomeria japonica* 'Elegans'
Deodar Cedar	*Cedrus deodara*
Douglas fir	*Pseudotsuga menziesii*
Dracaena Palm	*Cordyline australis*
Glossy Privet	*Ligustrum lucidum*
Honey locust	*Gleditsia triacanthos*
Locust	*Robinia pseudoacacia*
Lombardy poplar	*Populus nigra* 'Italica'
London Plane	*Platanus acerifolia*
Mexican Fan palm	*Washingtonia robusta*
Maritime pine	*Pinus pinaster*
Monterey cypress	*Cupressus macrocarpa*
Monterey pine	*Pinus radiata*
Moreton Bay fig	*Ficus macrophylla*
Myoporum	*Myoporum laetum*
Silver dollar gum	*Eucalyptus polyanthemos*
Sweetgum	*Liquidambar styraciflua*
Tulip poplar	*Liriodendron tulipifera*
Weeping willow	*Salix babylonica*

DBH:

All tree diameters were measured at Breast Height (DBH), or 4.5 feet above the ground. Double trunk or multi-trunked trees were measured below the main crotch for a representative diameter. If the trunks arose below or at the ground level, the diameter of the stems were averaged.

Tree Location:

Each tree was mapped. The Section number of the map is listed in the database, along with the nearest building number. Where buildings were not present, the street or area was described as shown on the map.

Description of Target:

A coded target description was identified for each tree. The target was considered to be the most likely item to be hit, should a failure occur. In other words, if the tree was near a building, but its failure would likely hit the lawn and not the building, then the lawn was listed as the target. The same codes were used as in the previous survey. Exceptions to this are identified below, with an asterisk (*) by the description number, and the changes in bold type:

*1 - Landscaping or Lawn was considered a low use area, **not an occupied yard.**
2 - Fence
3 - Sculpture or Pillar
4 - Bus Stop
5 - Path
6 - Sidewalk
7- Low Use Roadway
8- Bench
*9 - Children's playground or highly used yard. **Where evidence existed of family use of the yard, the target was rated as 9, rather than as 1.**
*10 - Main roadway. **Occupied parking areas were included in the Main roadway, since parking was not included elsewhere on the list.**
11 - Unoccupied Building
12 - Occupied Office or Day Use Building
13 - Occupied Residence
14 - Historic Building

Target Rating:

The target rating of each area was provided by the Park Service, in the form of a map. However, a target rating may have been upgraded or downgraded, depending upon the actual use of the area under the portion of the tree likely to fail. As in the above example, if the tree was determined likely to fail over a low use yard, rather than over an occupied building, then the target was described as 2 - Daytime exposure, rather than 3 - Overnight exposure. **Target Rating** - (From Field Sheet):

1 - Transitory Exposure
2 - Daytime Exposure
3 - Overnight Exposure

Defect Rating:

Defects were rated according to the Park Service guidelines, with the consultant's knowledge of the particular failure pattern of the species taken into account. A few items were added to the list provided by the Park Service, since recent research has shown certain factors to be important in terms of tree failures. These included branch attachments with included bark and/or decay and long limbs that were either heavy with foliage or exposed to winds. History of past limb breakage was also taken into account. Trees that have broken limbs in the past are far more likely to break additional limbs than those that have no such history. Likewise, live limbs that are heavy with foliage are more likely to cause serious injury than dead limbs that remain in trees. Hanging, broken branches were also considered a sign of potential hazard, unless there was only one limb that was securely lodged in the tree.

Defect Rating - (From Field Sheet)

1 - Low Level - Tree is beginning to show decline or has minor defects.
- Reduced top growth
- Foliage is abnormal color
- Foliage is thinner than normal
- Insect activity
- Canker, cat face or mechanical injury affects <1/3 diameter
- Heart rot/hollow affects < 1/3 diameter
- Dead limbs 2-4 inches in 20% of crown
- Dead limbs 4-6 inches in diameter in 10% of crown

2 - Medium Level - Visibly declining. Failure not readily apparent; judgment is there may be a shift to level 3 condition class within several years.
- Reduced growth, top of conifers are flattened
- Many dead or dying branches scattered throughout the crown
- Evidence of dead limbs having broken off
- Decay from rot tends to be localized
- Color of foliage obviously not normal
- Conifer crown has 1/3 to 2/3 branches dead; hardwood crown has 1/3 to 1/2 branches dead
- Cankers, cat faces affect from 1/3 and up to 1/2 diameter single conks
- Heart rot/hollow areas affect 30-70% of diameter
- Dead limbs 4-6 inches in 20-40% of crown
- Dead limbs 6-8 inches in 10-20% of crown
- Live green limbs with rot, hollow or dead areas
- Long heavy limbs which may break
- Included Bark at main crotch or major limbs

3 - High Level - Live, dying or dead tree or significant limb with visible defect or damage, which predisposes it to failing within 3 years.

Crown > 1/2 dead
Canker/Cat face affecting > 50% of diameter
Heart rot/hollow > 70% of diameter
Ground saturation
Dead limbs 4-6 inches diameter > 40% of crown
Dead limbs 6-8 inches affecting >20% of crown
Dead limbs >8 inches diameter
Live limbs rotted or splitting out
Multiple conks on bole or limbs 6"
Deferred removal could make tree more unsafe for employees
Live broken branches
Tree pulling out of ground
Long heavy limbs subject to failure
Included Bark at any crotch, with decay present

Discretionary Point:

This point was added to the defect rating if significant conditions existed, such as a predisposing condition of the tree (saturated soil, undermining stream bank, shallow soil, wind, the tree grew with a lean, etc.) or the potential for property damage to an unacceptable target (irreplaceable historic building, etc.)

Total Hazard Rating:

The final Target Rating was computed by adding points assigned for Target Rating, Defect Rating and Discretionary Point.

As stated earlier, all trees potentially impacting the areas surveyed were examined. Trees with defect ratings of 2 or 3, and with a hazard rating of 4 or higher are considered potentially hazardous and therefore were included in the database. (A small number of trees with a 1 defect rating were included in areas where no other hazardous trees were found. This allowed us to keep track of those areas surveyed.)

Recommended Work:

In addition to rating the trees for hazard, specific work was recommended to alleviate the hazard and further problems from developing. Discussion of this work is described in greater detail in the Discussion section of this report. Detailed Specifications are included in Appendix 4.

Recommended Work - (From Field Sheets):

1. Prune to remove dead branches (Clean)
2. Prune branches to reduce weight (Thin)
3. Cable, includes prior thinning before installation
4. Take down
5. Remove target

Comments:

Comments were added for most trees to further explain tree condition or location.

Photographs:

Appendix 5 contains photographs of all trees recommended for removal that were located in historically landscaped areas. Trees in forest areas, or backyards that were not formally landscaped were not photographed.

RESULTS AND DISCUSSION

The Park Service draft Standard Operating Procedures notes that any tree with a defect rating of 2 or higher and a Hazard Rating of 4 or higher shall be inspected annually. Those trees identified with a Hazard Rating of 7 shall have the hazard reduced or alleviated within 10 days.

We evaluated just over 1100 trees at the Presidio. Of these, 706, or 64%, were recognized as possible hazards, with a Hazard Rating of 4 or greater. Seventeen trees had a Hazard Rating of 3, with 11 of those having a defect rating of 2. One tree listed in the database was evaluated as having a 2 Hazard Rating. One tree was rated with a Hazard Rating of 7.

Table 1. Number of Trees in Each Hazard Rating

Hazard Ratting	Number of Trees	% of Trees	Average Diameter
1	None		
2	1 Tree	<1%	50"
3	17 Trees	2%	36"
4	358 Trees	49%	35"
5	262 Trees	36%	34"
6	85 Trees	11%	38"
7	1 Tree	<1%	54"

A summary of Target Ratings shows that 69% of the defects were rated as being over moderate exposure areas, while 21% were over high use targets with almost constant exposure. Ten percent (10%) of the hazards identified were over low use, or transitory exposure, areas.

Table 2. Summary of Target and Defect Ratings

Target Rating	Number of Trees	Average Diameter	Average Hazard Rating
1	65 trees	36"	4
2	504 trees	34"	4
3	155 trees	38"	5

Defect Rating	Number of Trees	Average Diameter	Average Hazard Rating
1	20 trees	33"	4
2	418 trees	36"	4
3	286 trees	35"	5

Medium levels of defects were observed in 57.7% of the trees, while 39.5% were identified as having high level defects. Of the trees identified in the data base, 2.7% were rated as having low level defects. This is in addition to the 376 trees evaluated, but not documented due to their low defect and target ratings.

Trees Given Discretionary Points

Discretionary Point	Number of Trees	Average Diameter	Average Hazard Rating
0	662 trees	35"	5
1	62 trees	34"	5

As would be expected, 91% of the trees were not given a discretionary point. However, 61 trees, or 8%, did receive an extra point. This was mostly due to lean or shallow root systems exposed by eroded soil. This point was also given for trees where the defect was likely to become worse in a very short period of time, or there were such factors as hanging limbs over high use areas.

Hazard Ratings and Number of Trees by Section

Section	Number of Trees	Average Diameter	Average Hazard Rating
1	5 trees	53"	5
2	None	-	-
3	44 trees	35"	5
4	87 trees	35"	5
5	23 trees	36"	5
6	104 trees	37"	5
7	156 trees	33"	5
8	185 trees	36"	5
9	26 trees	34"	4
10	29 trees	45"	4
11	65 trees	32"	5

Forty species were identified in this inventory of hazard trees. The percentages of trees found to be hazardous most likely correspond to the general population of trees located in the high use areas. Monterey cypress *(Cupressus macrocarpa)* was commonly listed, making up 33% of those trees identified as potentially hazardous. Monterey pine *(Pinus radiata)* comprised 25 % of the hazardous trees, while Blue gum *(Eucalyptus globulus)* accounted for 15%. Black acacia *(Acacia melanoxylon)* and Pink Ironbark *(E. sideroxylon)*, commonly planted around housing areas, accounted for 9% and 3% respectively of the hazardous trees. Red Flowering gum *(E. ficifolia)* and Dracaena palm *(Cordyline dracaena)* each accounted for 1% of the population of hazardous trees. The remaining 13% were spread out among the remaining 33 species.

Species Listing of Potentially Hazardous Tree

Species	Number of Trees	% of Hazard Trees	Average Diameter	Average Defect Rating	Average Hazard Rating
Monterey cypress	245 trees	33%	44"	2	5
Monterey pine	182 trees	25%	34"	2	5
Blue gum	112 trees	15%	38"	2	5
Black acacia	66 trees	9%	25"	3	5
Pink Ironbark	23 trees	3%	17"	3	4
Dracaena palm	13 trees	1%	18"	3	5
Red Flowering gum	11 trees	1%	24"	2	4
Misc. species	72 trees	13%	26"	2	4

A diameter distribution of the trees surveyed indicates that most of the trees are mature, and some are reaching over-maturity. This is particularly true of the species most often listed as potential hazards. However, there are trees in the smaller diameter ranges that will provide some replacement potential for the older trees. It should be noted, though, that some of these smaller trees are the same age as the larger ones, but are crowded in forest stands.

Diameter Distribution of All Trees Listed as Potential Hazards

Diameter Class	Number of Trees	Average Target Rating	Average Defect Rating	Average Hazard Rating
<12"	22	2	3	5
13" - 24"	169	2	2	5
25" - 36"	227	2	2	4
37" - 48"	176	2	2	5
49" - 60"	79	2	2	5
61" - 74"	36	2	2	5
74"+	15	2	3	5

BRITTON TREE SERVICES, INC.

Monterey cypress trees most often exhibited branch breakage, particularly where the trees were exposed to high winds, on the edge of roads and in open areas. this is fairly typical for the species. The other defect commonly seen was co-dominant trunks, resulting from the trunks being equal-sized. Bark becomes included between the two trunks as they grow against each other, creating a weakness at that point. Most Monterey cypress noted in the data base were greater than 36" in diameter, indicating they are reaching the final stage of their useful life.

Monterey pines also exhibited branch breakage, due mostly to long limbs that become very heavy with foliage. Most trees of this species range in size from 13" to 48" in diameter. Though many are mature, they can be expected to provide a good deal of landscape amenity to the Presidio for some time. Blue gums have a similar diameter distribution in the Presidio.

Diameter Distribution of Most Commonly Identified Species

<12"	13-24"	25-36"	37-48"	49-60"	61-72"	72"+
Monterey cypress						
3	18	7	79	13	25	10
Monterey Pine						
2	29	81	51	14	4	1
Blue gum						
0	23	41	25	13	6	5
Black acacia						
7	29	19	10	1		
Pink Ironbark						
2	21					

The high use areas surveyed found most of the hazard trees located around buildings, in yards or playgrounds, or along street or in parking areas. This is mostly a function of where the inventory was focused. Trees along streets that were not in yards were not inventoried in this first phase of the project, so the number of potential hazards in those areas would be expected to increase dramatically, once the inventory of all areas is complete.

Trees with Each Type of Target Description				
Target Description	Number of Trees	Average Diameter	Average Target Rating	Average Hazard Rating
1 - Landscaping	76 trees	32"	1	4
4 - Bus Stop	1 tree	43"	1	5
5 - Path	40 trees	32"	2	4
6 - Sidewalk	9 trees	24"	2	4
7 - Low Use Road	167 trees	36"	2	4
9 - Playground, Yard	147 trees	33"	2	2
10 - Main Road or Parking	75 trees	38"	2	4
11 - Unoccupied Building	32 trees	36"	2	4
12 - Occupied Office	1 tree	54"	2	5
13 - Occupied Residence	101 trees	37"	3	5
14 - Historic Building	75 trees	41"	3	5

Work was recommended to alleviate hazards, using the standards of current arboricultural practice, as outlined in the International Society of Arboriculture's *Tree Pruning Guidelines* and the American National Standards Institute's (ANSI) *A300 Standard for Shade Tree Pruning*. Both publications will use the terms Crown Cleaning for removal of dead branches, and Crown Thinning for further removal of live branches to reduce weight and windsail. Cabling was recommended where the tree was considered important enough to remain in the landscape, and where cabling would reduce the hazard to acceptable levels of risk. Cabling includes a complete cleaning and thinning of the tree prior to installation of cables. (See Recommendations and Discussion Section of this report for further information.)

Trees were recommended for removal when they were considered to be in poor heath or with such poor structure that pruning would not alleviate further hazards.

In the one situation, a toddler swing in a back yard was placed in a tree with broken hanging branches above it. The target could easily be moved to alleviate the hazard in this case.

Number of Trees Prescribed Each Type of Work			
Recommended Work	Number of Trees	% of Trees	Average Diameter
None	5 trees	<1%	36"
1- Prune to Clean	71 trees	9%	32"
2- Prune to Thin	433 trees	59%	[illegible]"
3- Thin & Cable	22 trees	3%	[illegible]"
4- Remove	192 trees	26%	[illegible]"
5- Move Target	1 tree	<1%	35"

RECOMMENDATIONS

Implement a Hazard Tree Management Plan

It is our recommendation that the Park Service personnel continue with implementation of an aggressive Hazard Tree Management Plan to alleviate or reduce potential hazards to an acceptable level of risk.

The Hazard Rating system used by the Park Service readily lends itself to prioritization of the work needed. Trees with the highest Hazard Ratings should be worked on first, continuing through each level until each tree is pruned or removed, depending upon the nature of the defect identified.

Appendix 3 of this Report lists trees in order of Hazard Rating for ease of identifying the trees to be worked on first. It is recommended that tree removals be bid separately from tree pruning, since removal work can be done by crews less skilled in pruning practices. We recommend that pruning contracts provide preference to contractors who are ISA* Certified Arborists, with a minimum requirement of at least one Certified Arborist and one Certified Tree Worker on each crew. Although Certification does not guarantee quality, it is a first step in qualifying the tree service is a professional company dedicated to quality work.

We have provided, in Appendix 4, a suggested set of Specifications for Tree Work. The terms used in these specifications are drawn directly from the ISA Pruning Guidelines and the proposed ANSI A300 Standard for Shade Tree Pruning. Additional considerations include safety, care of the adjacent landscape plants, wood disposal, timing to protect wildlife during breeding season, and inspection.

We recommend a qualified consultant be retained to inspect the first contract for tree pruning. The consultation should also include review of the contract documents and bid list presented to the potential bidders. A pre-bid tour is considered routine, and should be required of all potential bidders at a specified time and place. This insures that all contractors receive the same information regarding details of the work. Park Service personnel assigned to oversee tree maintenance should accompany the consultant at the pre-bid tour and on all inspections to receive training in current arboricultural standards, and to become familiar with the requirements of inspecting this type of work as well as the terms used in the specifications.

No matter how well a specification is written, regular inspections during the work are absolutely necessary to obtain a high standard of work performance.

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* International Society of Arboriculture

Maintain a Regular Monitoring Schedule with Trained Staff

Those trees with the lower Hazard Ratings of 2 or 3 do not require work in the scope of this Plan. However, these trees should still be inspected every 3 to 5 years to insure they do not develop hazards that should be taken care of before their scheduled maintenance. Trees with a hazard rating of 4 or higher should be inspected annually, as is stated in the Park Service's draft Standard Operating Procedures.

Assign one to three people to evaluate trees. Provide training in tree hazard assessment and in pruning and inspection techniques so they can oversee contracts.

Maintain a Regular Pruning Cycle

Regular, systematic pruning of trees has been shown to be less expensive than pruning trees on an absolute need basis. Problems can be predicted and taken care of prior to branches or trunks breaking, preserving both the aesthetic and property values of the trees. Proper management and pruning also provides a safer and more secure environment for the people who recreate under the trees. A systematic tree management program will reduce long-term costs and is actually the least expensive and most fiscally responsible method of maintaining a community's tree resource. (Miller & Sylvester, 1981.)

However, the Presidio is faced with a significant problem in terms of implementing such a program. The most obvious is inheriting a set of older trees that have been minimally maintained, and the extensive cost of pruning or removing these trees in order to reduce risks to an acceptable level. It will no doubt take ten or more years to actually prune or remove the trees with potentially hazardous conditions. But once this is accomplished, the Park Service should keep the trees in high use areas systematically pruned. This will require an annual budget set aside specifically for tree care, training personnel and for re-planting efforts.

Although many of the trees are older and some are declining, there exists at the Presidio a number of landmark trees well worth the effort and cost of preserving through careful maintenance. Some decisions will obviously need to be made about the cost of preserving certain trees versus the benefits and/or aesthetic value of the tree. We recommend that once a tree has significant decay due to past injuries, that it seriously be considered for replacement. This may, in some situations, still require pruning the tree at least once to reduce its hazard potential while a new tree is established.

Improve Planting Procedures

Trees should generally be planted using the techniques identified by the University of California, in Leaflets #2576 and #2583 (See References Used). These techniques call for the planting hole to be dug twice the diameter of the container from which the tree is transplanted and no deeper. The tree should be placed in the hole so that the original root collar is 2 to 3 inches above the final grade. It should be noted that most trees are planted too deep in containers, so the soil on top of the root ball should be taken off to the point where the first major root of the tree lies just below the soil line. This root, then, should be visible, just above the final grade.

No rigid root barriers should be needed in the Presidio's soil. If sidewalk damage has been a problem in the past, plastic or copper screen can be placed vertically at the edge of the pavement to be protected, to a depth of 18 inches. If there has been a problem with roots surfacing in lawn areas, then the irrigation practices need to be re-evaluated and changed to a longer, less frequent cycle to encourage deeper rooting and better soil aeration.

Staking should be used only when absolutely needed to keep the trunk upright. In this situation, 2 stakes should be placed outside the root ball and into native soil, so that they are perpendicular to the prevailing winds. The tree should be loosely attached to the stakes so that it can bend in the wind. Stakes should be left on for no more than 2 seasons of growth. Coniferous trees generally should not be staked.

If there is a concern about tree protection from vandalism, then a barrier of three or four stakes should be placed around the tree, without ties to the trunk.

For best establishment, a basin should be provided around the tree for irrigating the first two years by hand. This basin should begin about 4 inches inside the original root ball, and extend out 6 inches beyond the root ball the first year. It should be filled three times and allowed to drain, twice a week for the first 6 weeks and weekly thereafter. Irrigation during the second growing season should take place every 10 to 14 days. The basin should be enlarged the second season to encompass one or two more feet. This will encourage the roots to become established farther from the tree. If basins are impractical in some locations, drip emitters can be used. There must be at least four emitters per tree, placed at the edge of the root ball, not near the trunk. These should be moved out the second year, and increased in number, to encourage more extensive rooting of the trees.

It is important for tree health and optimal growth that at least one foot of bare or mulched soil be maintained around the tree's trunk. This will accomplish two things: the tree's roots will have less competition from lawn or other ground covers and lawn mowers will not need to mow around the tree, causing injury to the trunk. Ivy and other ground covers should routinely be kept at least 1 to 3 feet from tree trunks. When native California oaks are planted, the area under the canopy should be kept mulched and free of landscape plants, including lawn.

Some amendment should be added to the soil when planting trees in sandy soils. We recommend that the soil in the planting hole be amended with 1 part of organic matter to every 3 parts of backfill soil. Increasing this ratio could result in the tree roots staying inside the amended soil area, creating future anchoring problems.

Improve Cultural Conditions for Tree Growth

Two practices need to be changed around existing trees, which have already been mentioned for new tree planting.

1. Keep ivy and other ground covers off tree trunks, and pruned back at least three feet. This allows defects in the trunks to be readily recognized and reduces the need to irrigate tree trunks, which can lead to crown rot disease, or *Phytophthora sp.*

2. Change irrigation cycles to apply more water, less frequently. This encourages deeper rooting of both the ground covers, as well as the trees. It also allows drainage to take place, reducing the chances of saturated soils and crown rot development.

Improve Species Selection

The trees most commonly found at the Presidio are those well adapted to the salt winds and mild summers. However, these species are also prone to branch breakage. Selection of species other than Monterey cypress, Monterey pine and eucalyptus should be seriously considered in high use areas where cultural resource values would not be compromised. These trees do, however, lend themselves to forest groves and can make good specimens when regularly maintained. Good replacements include Deodar cedar *(Cedrus deodara),* Incense cedar *(Calocedrus decurrens),* Norfolk Island pine *(Auracaria heterophylla)* Port Orford cedar *(Chamaecyparis lawsoniana).,* and Coast Live oak *(Quercus agrifolia)*, as tree native to the Presidio.

Black acacia *(Acacia melanoxylon)* and Pink Ironbark *(Eucalyptus sideroxylon)* should be avoided wherever possible due to their nature of having poor branch structure and their susceptibility to branch breakage and decay.

QUALIFICATIONS OF CONSULTANTS

Britton Tree Services, Inc. is an established tree care company serving the Napa Valley and surrounding areas since 1976. The consultants have extensive experience in helping public agencies care for their trees. Below are the qualifications of the consultants who worked on the project.

Denice Froehlich Britton, Consulting Arborist

Denice has over 14 years experience in tree evaluation and inventory techniques . She has been the Project Director for many Tree Inventories, evaluating 100 or more trees, during the last 5 years. Her expertise lies in Tree Hazard Evaluation, Tree Inventory Design, Data Analysis, and Report Writing. Prior to joining Britton Tree Services, Inc., Denice was the Urban Forestry Specialist for the University of California at Berkeley for three years, where she specialized in helping City Personnel develop Tree Management Programs.

As Project Director, she developed the inventory format, coordinated field activities, mapping and evaluation of trees, data analysis and is the main author of this report. She coordinated the activities of all other project personnel.

John C. Britton, Consulting Arborist

Mr. Britton has over 25 years experience in pruning and caring for trees. His career began in Oakland, working for Entriken Tree Service. He has owned Britton Tree Services, Inc. in St. Helena since 1976. He has extensive experience in evaluating trees for hazard, and in estimating tree work. His expertise in pruning practices is illustrated by his Chairmanship of the ISA Committee to develop the publication *Tree-Pruning Guidelines*.

He was responsible for evaluating the trees, determining maintenance needs and prioritizing the work. He also reviewed the written report.

As a Team, the Consultants bring a unique blend of practical experience in all aspects of tree care, and expertise in developing management programs. Both are ISA Certified Arborists and have been accepted as active members of the American Society for Consulting Arborists. Their field assessments concentrate on factors known to create potential hazards, and cultural conditions known to reduce tree vigor.

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APPENDIX 1

MAPS OF TARGET RATINGS

(in GGNRA files)

BRITTON TREE SERVICES, INC.

APPENDIX 2

LIST OF TREES IN ORDER OF MAP SECTION

(in GGNRA files. The data provided for each hazard tree is described on the following page.)

BRITTON TREE SERVICES, INC.

DATA FIELD SHEET
Presidio San Francisco

Tree# - Same number as previous survey, if tagged. If not tagged, a number beginning with 8000 will be assigned. Trees will be mapped.
Tree Species - Common Name
DBH - Diameter at Breast Height, or 4.5 feet above the ground. DIAMETER of multi-trunk tree will be taken below the division of trunks, to provide a representative diameter.
Tree Location
- Section #, as indicated on maps provided.
-Building number will be used if appropriate.

Description of Target
1 - Landscaping, lawn
2 - Fence
3 - Sculpture or Pillar
4 - Bus Stop
5 - Path
6 - Sidewalk
7 - Low use Roadway
8 - Bench
9 - Children's Playground or Yard
10 - Main Roadway or Parking
11- Unoccupied Building
12 - Occupied Office or day use building
13 - Occupied Residence
14 - Historic Building

Target Rating -
1 - Transitory Exposure
2 - Daytime Exposure
3 - Overnight Exposure

Defect Rating -
1 - Low Level - Tree is beginning to show decline or has minor defects.
Reduced top growth
Foliage is abnormal color
Foliage is thinner than normal
Insect activity
Canker, cat face or mechanical injury affects <1/3 diameter
Heart rot/hollow affects < 1/3 diameter
Dead limbs 2-4 inches in 20% of crown
Dead limbs 4-6 inches in diameter in 10% of crown

2 - Medium Level - Visibly declining. Failure not readily apparent; judgment is there may be a shift to level 3 condition class within several years.
Reduced growth, top of conifers are flattened
Many dead or dying branches scattered throughout the crown
Evidence of dead limbs having broken off
Decay from rot tends to be localized
Color of foliage obviously not normal
Conifer crown has 1/3 to 2/3 branches dead; hardwood crown has 1/3 to 1/2 branches dead
Cankers, cat faces affect from 1/3 and up to 1/2 diameter single conks
Heart rot/hollow areas affect 30-70% of diameter
Dead limbs 4-6 inches in 20-40% of crown
Dead limbs 6-8 inches in 10-20% of crown
Live green limbs with rot, hollow or dead areas
Long heavy limbs which may break
Included Bark at main crotch or major limbs

3 - High Level - Live, dying or dead tree or significant limb with visible defect or damage, which predisposes it to failing within 3 years.
Crown > 1/2 dead
Canker/Cat face affecting > 50% of diameter
Heart rot/hollow > 70% of diameter
Ground saturation
Dead limbs 4-6 inches diameter > 40% of crown
Dead limbs 6-8 inches affecting >20% of crown
Dead limbs >8 inches diameter
Live limbs rotted or splitting out
Multiple conks on bole or limbs 6"
Deferred removal could make tree more unsafe for employees
Live broken branches
Tree pulling out of ground
Long heavy limbs subject to failure
Included Bark at any crotch, with decay present

Discretionary Point - Added if significant conditions exist such as a predisposing condition of the tree (Saturated soil, undermining stream bank, shallow soil, wind, grew as lean, etc.) or to an unacceptable target (irreplaceable historic building, etc.)
Total Hazard Rating = Computed by adding points assigned above.

Recommended Work - to alleviate hazard
1. Crown Cleaning - remove dead branches
2. Crown Thinning - to reduce weight
3. Cab[illegible]s thinning before installation
4. Take [illegible]
5. Remove target

Comments - As needed to further explain tree condition or location.

APPENDIX 3

LIST OF TREES IN ORDER OF HAZARD RATING

(in GGNRA files. The data provided for each hazard tree is described on the following page.)

DATA FIELD SHEET
Presidio San Francisco

Tree# - Same number as previous survey, if tagged. If not tagged, a new number beginning with 8000 will be assigned. Trees will be mapped.
Tree Species - Common name
DBH - Diameter at Breast Height, or 4.5 feet above the ground. DIAMETER of multi-trunk tree will be taken below the division of trunks, to provide a representative diameter.
Tree Location
- Section #, as indicated on maps provided.
-Building number will be used if appropriate.

Description of Target
1 - Landscaping, lawn
2 - Fence
3 - Sculpture or Pillar
4 - Bus Stop
5 - Path
6 - Sidewalk
7 - Low use Roadway
8 - Bench
9 - Children's Playground or Yard
10 - Main Roadway or Parking
11- Unoccupied Building
12 - Occupied Office or day use building
13 - Occupied Residence
14 - Historic Building

Target Rating -
1 - Transitory Exposure
2 - Daytime Exposure
3 - Overnight Exposure

Defect Rating -
1 - Low Level - Tree is beginning to show decline or has minor defects.
Reduced top growth
Foliage is abnormal color
Foliage is thinner than normal
Insect activity
Canker, cat face or mechanical injury affects <1/3 diameter
Heart rot/hollow affects < 1/3 diameter
Dead limbs 2-4 inches in 20% of crown
Dead limbs 4-6 inches in diameter in 10% of crown

2 - Medium Level - Visibly declining. Failure not readily apparent; judgment is there may be a shift to level 3 condition class within several years.
Reduced growth, top of conifers are flattened
Many dead or dying branches scattered throughout the crown
Evidence of dead limbs having broken off
Decay from rot tends to be localized
Color of foliage obviously not normal
Conifer crown has 1/3 to 2/3 branches dead; hardwood crown has 1/3 to 1/2 branches dead
Cankers, cat faces affect from 1/3 and up to 1/2 diameter single conks
Heart rot/hollow areas affect 30-70% of diameter
Dead limbs 4-6 inches in 20-40% of crown
Dead limbs 6-8 inches in 10-20% of crown
Live green limbs with rot, hollow or dead areas
Long heavy limbs which may break
Included Bark at main crotch or major limbs

3 - High Level - Live, dying or dead tree or significant limb with visible defect or damage, which predisposes it to failing within 3 years.
Crown > 1/2 dead
Canker/Cat face affecting > 50% of diameter
Heart rot/hollow > 70% of diameter
Ground saturation
Dead limbs 4-6 inches diameter > 40% of crown
Dead limbs 6-8 inches affecting >20% of crown
Dead limbs >8 inches diameter
Live limbs rotted or splitting out
Multiple conks on bole or limbs 6"
Deferred removal could make tree more unsafe for employees
Live broken branches
Tree pulling out of ground
Long heavy limbs subject to failure
Included Bark at any crotch, with decay present

Discretionary Point - Added if significant conditions exist such as a predisposing condition of the tree (Saturated soil, undermining stream bank, shallow soil, wind, grew as lean, etc.) or to an unacceptable target (irreplaceable historic building, etc.)
Total Hazard Rating = Computed by adding points assigned above.

Recommended Work - to alleviate hazard
1. Crown Cleaning - remove dead branches
2. Crown Thinning - to reduce weight
3. Cable, includes thinning before installation
4. Take down
5. Remove target

Comments - As needed to further explain tree condition or location.

APPENDIX 4

SPECIFICATIONS FOR TREE WORK

BRITTON TREE SERVICES, INC.

SPECIFICATIONS FOR TREE WORK

I. GENERAL CONTRACT CONDITIONS:

1. LOCATION:

As specified by the Contract or Work Order.

2. SITE INSPECTION:

It is understood that the Contractor has examined the site and has full knowledge of the conditions and difficulties to be met. No variations or allowances from the contract sum will be made because of such lack of knowledge. **Bidders are required to attend the pre-bid tour of the work area.**

3. CONTRACT:

As per attachments to these Specifications.

4. PERMITS AND NOTIFICATION:

Prior to performance of work, the contractor shall procure all permits and licenses as may be required by the Park Service and/or the City of San Francisco. A California State Contractor's License for tree work (C61/D49) is required by law.

5. DAMAGE TO TREES AND SHRUBS:

It is the objective of this Contract to preserve and enhance the landscape. Therefore, damage to any trees, shrubs, lawn or real property will not be tolerated. Damage to trees or shrubs will result in an assessment by a qualified arborist. Damage assessment of trees and shrubs will be guided by the system of evaluation outlined in the publication entitled *Guide for Plant Appraisal*, 8th Edition, written by the Council of Tree and Landscape Appraisers in 1992 and published by the International Society of Arboriculture, Savoy, IL.

On the basis of the system established by the International Society of Arboriculture, the basic value of a tree or shrub is established using its diameter and the cost of replacing a tree with the same species. This basic value is then modified by the plant's condition and location to reflect the actual landscape value.

On partially damaged plants, a percentage of the above figure will be applied. The Park Service reserves the right to require replacement, by planting, of badly damaged trees or shrubs. All damaged or destroyed plants will remain the property of the National Park Service.

6. DAMAGE TO REAL PROPERTY:

In the event that damage occurs to real property, notification will be given to the job inspector, or the Forester for the Presidio, before leaving the grounds that day. This damage shall be repaired by the Contractor at his expense to the satisfaction of the Park Service. Unless otherwise arranged, repair of damage to real property will be completed before final payment is made to the Contractor.

7. PREVENTION OF DAMAGE TO VEGETATION AND LANDSCAPE:

The Contractor shall use all possible methods available to him to prevent damage to surrounding landscaping, roads and structures, including the following:

Equipment shall be kept on specified roads and driveways to minimize damage to planted areas.

Limbs cut from the tree that may cause damage to lower limbs, vegetation or asphalt must be lowered from the tree on a rope.

Climbing gaffs (hooks) shall not be used to climb trees except for takedowns or as an emergency measure to rescue an injured climber.

Limbs that cannot be held by one hand, or those greater than three inches (3") in diameter shall be pre-cut to prevent splitting or peeling of the wood and bark.

8. PUBLIC SAFETY:

The Contractor shall be responsible for public safety, including:

The placement of barricades, warning cones, or roping off an area in which work is taking place.

Traffic and pedestrian control.

Maintenance of a clean right-of-way at the end of the working day on sidewalks, streets and driveways. If objects are left in the right-of-way overnight, they must be coned off.

Any brush chipper left unattended shall have the hopper closed, the ignition locked, and the key removed.

Ropes shall be pulled out of the tree at the end of each working day.

Saws and other tools, when not in use, shall be secured.

Each crew shall have an easily accessible fire extinguisher, first aid kit, and a list of local emergency telephone numbers easily accessible.

9. WILDLIFE

If active nests are found in trees to be treated, or in trees in the process of pruning or other treatment, or if any wildlife is inadvertently injured or killed, park staff shall be immediately contacted, prior to proceeding further, to allow appropriate action to be taken.

10. LICENSES AND QUALIFICATIONS OF CONTRACTORS:

Before commencing work, Contractors must be licensed as a business in the City where the work is taking place. License numbers must be entered on the bid form where space is provided.

Contractors shall provide in the bid package a Certificate of Insurance showing at least $1,000,000 coverage and a Certificate of Worker's Compensation Insurance.

A minimum crew shall consist of a fully-qualified climber, having a minimum of two year's experience in pruning ornamental and shade trees, and an arborist-foreman directing the work. The foreman shall be a Certified Tree Worker or Arborist with a minimum of three years experience in all aspects of arboriculture.

Preference will be given to Contractors who are Certified as an Arborist by the International Society of Arboriculture (ISA). The Contractor shall have a minimum of five (5) years experience in a supervisory capacity. He shall be responsible for all decisions made on the job and must visit the job site daily.

II. WORK TO BE PERFORMED

1. ROOT COLLAR EXCAVATIONS:

Where prescribed, the tree will receive an examination of the root collar area to determine the root collar's condition, i.e. presence of decay, girdling roots, structural soundness, presence of dead tissue indicating disease, soil level changes or buildup of debris. Injuries to lower trunk will be examined to determine proper development of callus tissue. Where tissue has died back under the bark, the dead bark shall be removed to live callus without breaking into the compartment wall. Should any cavity excavation reveal structural weakness or a dangerous situation, the Contractor shall bring the situation to the immediate attention of Forester for the Presidio for review.

Techniques:

Any tree recommended for a root collar examination prior to construction should be excavated using the following guidelines under the supervision of the Consulting Arborist.

1. A Root Collar Excavation consists of removing soil, lawn, ivy and other debris or plants from the base of the tree down to the original grade on all sides. The root flares shall be cleaned and exposed for six to twelve inches below the original soil level. In extreme situations, and with larger trees, the root flare may need to be exposed much farther out to properly examine its condition.

2. If excavations reveal extensive decay in the original roots, and adventitious roots are not large enough for support, the tree shall be recommended for removal.

3. If excavations reveal greater than 25%, yet less than 50%, dead tissue at the root collar, the tree should be evaluated in terms of:

   a. Remaining anchoring roots in relation to distribution of canopy weight.
   b. Cause of the injury and/or the aggressiveness of the disease or insect in relation to the vigor of the tree.
   c. Remedial treatment and/or change of cultural conditions necessary to reduce the spread of the injury.

4. After examination, healthy roots shall be recovered with soil to the original grade, or the edge of the coarse, above ground bark.

   a. Do not backfill until the Consulting Arborist has examined the exposed collar and authorized it. If the excavation must remain open for more than 12 hours, the roots shall be covered with burlap or plywood and clearly marked to warn pedestrians of the hazard.
   b. No root pieces or green organic material shall be included in the backfill.
   c. The bark crevices shall be cleared of dirt using a whisk broom or stiff bristled brush.

5. Where the root collar is considered healthy, soil will be left at the original or natural grade. Whenever a root crown excavation is expected to (or begins to) exceed 6 inches in depth, the Parks Superintendent will be notified immediately.

6. Unhealthy root conditions shall be left exposed for regular inspection and treatment.

7. Excavations must be clearly marked to warn and guide pedestrian traffic at all times.

8. Where necessary, tree wells or grates will be installed by the Park Service under separate contract.

2. PRUNING -

General Requirements:

Trees are to be pruned as directed on the bid form; each method is described below.

Trees shall not have their branches or tops shortened, they are to be left in their natural form.

Climbing gaffs (hooks) shall not be used to climb trees except for takedowns or as an emergency measure to rescue an injured climber.

3. YOUNG TREE PRUNING

Improving Crown Structure:

Structural pruning refers to pruning young trees to establish a good branch spacing and develop strong branch attachments.

A general goal is to have branches spaced at least 3" to 6" apart up and down the trunk as well as radially around the trunk. For large growing trees, main branches are to be 9" to 12" and up to 18" apart.

For best attachment, branches should generally be less than 3/4 the size of the trunk or parent limb. where branches are larger than this and beginning to compete with the leader, they are to be removed completely to the trunk or the competing branch can be thinned as much as 50% near the end to slow its growth.

4. MATURE TREE PRUNING

a. Crown Cleaning:

This method of pruning consists of the removal of dead, dying or weak, diseased, rubbing or otherwise interfering branches.

Minimum diameter of branches that are removed is one-half inch (1/2") in the leaf canopy area. Limbs more than three inches (3") in diameter shall be pre-cut to prevent splitting or peeling of the wood and bark.

There is no minimum diameter along the trunks and scaffold limbs for dead or weak sprouts and branches. Well-placed inside branches shall be left on the tree to promote taper of limbs.

Basal suckers and root sprouts up to 4" in diameter are to be removed from all trees.

All cuts shall be made just outside the branch bark ridge and collar. On dead limbs, cuts shall be made so as not to injure any callus development. The finished cut surfaces shall be smooth and in one plane with no jagged edges or torn bark.

b. Crown Thinning:

Thinning refers to pruning of live branches and limbs for reasons of health, safety and appearance. Thinning is to be used where branch foliage is so thick as to cause a "wind-sail" effect or is so heavy as to increase the probability of limb breakage. At no time shall large holes be left in the canopy. Care must be taken to prevent exposure of upper limbs to direct sunlight, which may cause sunscald and branch weakening.

Prune to clean the tree as described above. In addition, thin limbs that are heavy or dense with foliage. Trees with equal sized, or co-dominant, trunks shall have one limb thinned more than the other to slow its growth in relation to the parent branch. The final result will be a more open canopy.

Thinning cuts are to be made in the outer third of the branch. Thinning cuts generally remove limbs two (2") inches in diameter and smaller. A maximum of one-third (1/3) the foliage of the tree shall be removed. Well placed inside branches are to be left on the tree to promote limb taper.

c. Crown Restoration:

Crown Restoration is the improvement of the structure, form and appearance of trees with branches that have been severely headed (or topped), or storm damaged.

Crowded branches at or near the end of the branch stubs shall be thinned out so as to leave 2 to 5 well-spaced sprouts around the cut (or broken) end. By thinning the number of sprouts and exposing those remaining to more sunlight, horizontal branches should form along their length. Therefore, these sprouts should not be shaped back during the first restoration pruning.

The tree should be re-pruned 2 years later to further thin out the number of sprouts or to reduce the size of the sprouts and encourage lateral development if no natural laterals have formed.

d. Crown Shaping (or Crown Reduction):

Crown Shaping reduces the spread of a tree.

Shaping shall be accomplished by removing branches to the trunk wherever feasible. Otherwise, shaping shall consist of removing the longest portion of a limb to a lateral large enough to assume the terminal role, or at least 1/2 the size of the branch being removed. The remaining branch can be thinned, but is not to be shaped back.
No more than 1/3 of the total leaf surface of the crown shall be removed.

5. CABLING

Materials and Procedures

In the event that a branch has been weakened by a cavity or poor attachment, or is subject to high winds, a box cable system will be installed.

The foliage will be thinned before cabling begins. Any rodding or bracing shall take place before cabling.

Cables shall be installed in the upper third of the branch area, as high as is reasonably possible. Cables are to be attached to the tree by use of a cast steel lag hook or lag eye, or by means of a bolt through the limb, if decay is present. All hardware will be galvanized or otherwise coated against rust. Eyes shall be dropforged rather than bent to shape.

Holes drilled for lag screws shall be one-sixteenth (1/16") of an inch smaller than the outside thread diameter, and one-eight (1/8") of an inch deeper than the length of the threads. The holes for bolts are approximately the diameter of the bolt.

Lags and hooks shall be in direct line with the cable and, as much as possible, enter the limb at approximately 90 degrees to the surface. Only one cable may be attached to any hook, eye or bolt. An effort should be made to keep all the cables in one plane.

Before installing nuts on bolts, the bark may be traced away to the cambium. Care must be taken not to injure the sapwood. Washers are to be round or oval, not diamond-shaped. All nuts will have washers under them, and shall be tightened down with a socket wrench to prevent injury to the bark. A thimble must be used under the cable where it passes through the hook or eye.

When using common grade cable, splicing shall consist of four wraps with each strand; all seven strands must be wrapped.

Pre-formed tree grips shall be used with extra high strength cable of one-quarter inch (1/4") or three-sixteenths inch (3/16") only.

Cable tension shall be taut but not tight.

ACCEPTABLE CABLING MATERIALS

Limitations Load Lbs	Limb Diam	Anchor Units Lag Screw / Threaded Diam.	/ Rod	Flexible Cable 7 Strand Galvanized Wire
500	6-8"	1/2"	---	1/4" common grade
900	8-14"	5/8"	---	5/16" common or 3/16" extra high strength (EHS)
2000	10-20"	---	3/4" amon.nut	1/4" EHS or 3/8" common
3000	15-28"	---	3/4" amon nut	1/4" EHS or 3/8"common
3700	30"+	---	7/8" amon	5/16" EHS or 1/2" common

6. TAKE DOWN:

Trees designated for removal will be clearly marked. Trees will be taken down in a manner consistent with the health and safety of the tree climbing crew and the general public. Damage to other trees or shrubs must be avoided. Climbing gaffs or hooks may be used when removing trees. All stumps are to be routed six (6") to twelve (12") inches below the soil level.

III. WOOD DISPOSAL AND CLEAN UP:

All brush shall be chipped and the chips stockpiled on site at the direction of the Forester for the Presidio. All wood which cannot be chipped shall be disposed of at the Contractor's expense, or at the discretion of Forester for the Presidio, be left stacked neatly on site near the site of the tree's trunk.

IV. INSPECTION:

An authorized Arborist or the Forester for the Presidio shall at all times have access to the work whenever it is in preparation or progress and the Contractor shall provide proper facilities for such access and for inspection. Inspection of the work shall not relieve the Contractor of any of his obligations to fulfill his contract as prescribed. Final inspection of work shall be made after all work under this contract has been completed and the final clean up performed.

Appendix C. Some Observations of the Early Explorers

Some Observations of the Early Explorers

The journals of early explorers reveal much about the distribution of native vegetation on the San Francisco Peninsula. Journal excerpts, as provided by Clarke (1959), were used in the preparation of Figure 2-1, "Probable Prehistoric Native Vegetation Communities". Some of the more interesting passages are recounted here.

Near Mountain Lake

In H. E. Bolton's (1930) account of Anza's California expeditions, Father Font, a priest accompanying the expedition, described the area near Mountain Lake: "This place and its vicinity has abundant pasturage, plenty of firewood, and fine water, all good advantages for establishing here the presidio. . . . It lacks only timber, for there is not a tree on all those hills, though the oaks and other trees along the road are not very far away. . . . Here and near the lake there are yerba buena and so many lilies that I had them almost inside my tent."

Anza agreed with Font's opinion of the Mountain Lake area. There was "much firewood and good pasturage, sufficient and even in superabundance for pasturing cattle. But along with these good qualities one must mention the lack of timber, for in the district examined there is none even for barracks."

Fort Scott Area

Font reports that the party "entered upon a mesa that was very green and flower-covered, with an abundance of wild violets. The mesa is very open, of considerable extent, and level, sloping a little toward the harbor."

East of the Presidio

From the hills of the Presidio, Font went down to the beach of the marina and from there "continued along a plain in an opening made by some hills, all of very good land and well grown with grass and other herbs. In the middle of it there is a small lake like a fountain or spring of fresh water with tule. . . . It appears that this water is permanent because at the foot of the hills in their canyons it is very green and shady, with plentiful small trees. We climbed another hill

and then entered a very thick grove of scrubby live oak and other small trees and brush which continues for a considerable stretch over the hills along the shore of the estuary."

Anza's account of the same area contains some different details. "Very soon after leaving the vicinity of our camp [Mountain Lake] I began to find running water, an infinite supply of firewood, timber for barracks, mostly of oak, both green and dry and of good thickness, but bent toward the ground because of the constant northwest winds on this coast."

Southeast of the Presidio

On their return journey to Monterey, the members of the Anza expedition left the camp at Mountain Lake, marched eastward, then southward, probably between Pacific Heights and Nob Hill, to the future site of Mission Dolores. Font reports that "passing through wooded hills and over flats with good land, in which we encountered two lagoons and some springs of good water, with plentiful grass, fennel, and other useful herbs, we arrived at a beautiful arroyo which, because it was Friday of Sorrows, we called the Arroyo de Dolores. On its banks we found much and very fragrant manzanita and other plants, and many wild violets."

George Vancouver, the noted English navigator and explorer of the west coast, visited the Presidio in 1792-1793. He found that the ride between the Presidio and Mission Dolores "was rendered unpleasant by the soil being very loose and sandy, and by the road being much incommoded with low groveling bushes. . . . The barren sandy country through which we had passed, seemed to make a natural division between the lands of the mission and those of the Presidio, and extends from the shores of the port to the foot of a ridge of mountains which border the exterior coast and appear to stretch in a line parallel to it. The verdure of the plain (about the mission) continued to a considerable height up the sides of these hills; the summits of which, though still composed of rugged rocks, produced a few trees."

Bayside Areas

Archibald Menzies, the official naturalist in the Vancouver party, reports that the shore around Yerba Buena Cove (now Aquatic Park lagoon) was in many places covered with bushes "of a stunted scrubby appearance and not very numerous in variety. . . ." These thickets were largely composed of *Quercus agrifolia*, but *Pholinia arbutifolia*, *Aesculus californica*, *Ceanothus thyrsiflorus*, *Baccharis pilularis*, *Eriogonum arcolar*, *Salix lasiolepis*, *S. lasiandra*, and *Lonicera involucrata* were also present.

Menzies noted that the shore of the bay just east of Fort Point and north of the Presidio was lined by a low tract of marshy ground. Firewood was difficult to acquire as there was only scrubby brush wood on the side of an adjacent hill.

Vancouver reports that the marshy ground was a seawater lagoon between the beach and the mainland. The brush was small, bushy *Quercus agrifolia*. Fresh water was secured from a low space behind the beach, which was covered with a spiny grass and flooded with rain. When they returned the following October, this area was quite dry and the hills surrounding the Presidio appeared barren.

Citation

Clarke, W. C. 1959. Vegetation cover of the San Francisco region in the early Spanish period. Master of Science thesis. University of California. Berkeley, CA.

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Appendix D. Updated Forest Stand Inventory

Updated Forest Stand Inventory

This appendix contains an inventory of the Presidio forest stands. It gives acreage, species, stand vigor, wildlife rating, understory vegetation sensitivity, and soil-geologic-vegetation type for each stand shown in Figure 3-4 in Chapter 3. The recommended allocation of each stand to a particular management emphasis area described in Chapter 5 of the plan is also given.

This inventory is based on the partial survey of Presidio forests by McBride (1984; see citation in Chapter 9), as updated by Jones & Stokes Associates for this report. The understory vegetation sensitivity ratings were provided by the volunteers and staff of the Natural Resources Division of the Golden Gate National Recreation Area. Stands 1-235 were assigned by McBride (1984). Stands 236-584 were assigned by Jones & Stokes Associates and have not been assigned a wildlife rating or vigor because they lack data from the McBride study. Stands with native vegetation types of oak or willow that were assigned stand numbers by McBride are also included in this inventory table. These stands are treated as native vegetation in this report and are illustrated in Figure 3-2, instead of Figure 3-4.

Table D-1. Updated Forest Stand Inventory

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
1	C	13	M	ABC	4611	NR	1.8
2	C	19	M	ABC	4611	H	0.8
3	P	19	M	ABC	4611	M	0.3
4	C	19	M	AC	4611	H	1.3
5	A	19	L	ABC	4611	M	0.1
6	CP	19	L	ABC	4611	H	0.3
7	E	19	M	ABC	4611	H	0.7
8	E	23	M	ABC	4611	H	1.3
9	E	0	H	D	2111, 4411	M	0.7
10	E	0	M	ABC	2111, 2211, 4411, 5000	M	0.4
11	E	26	M	ABC	4411, 4611	M	2.3
12	E	16	M	ABC	4411	M	0.6
13	C	16	M	NR	4611	M	0.3
14	E	16	M	NR	4611	M	0.2
15	C	16	L	NR	4611	M	0.3
16	A	16	L	ABC	2211, 4411, 4611	M	0.7
17	CP	27	L	ABC	4411	L	0.7
18	E	16	L	ABC	4411	M	0.3
19	E	16	M	AC	2211, 4411	M	1.5
20	E	16	M	ABC	2211, 4611	M	1.9
21	CP	22	M	AC	2211, 2221, 2222, 4111	L	1.6
22	C	22	L	ABC	2211, 3111	L	2.2
23	CP	22	M	NR	2211, 3111	L	1.6
24	CP	28	L	ABC	3111	L	0.3
25	P	28	L	ABC	2211, 3111, 4111	M	0.4
26	E	28	L	AC	3111	M	0.2
27	E	28	M	NR	3111, 4111	M	0.1
28	C	28	L	NR	2211, 4111	L	0.2
29	CPA	28	L	NR	3111	H	0.2
30	P	28	L	ABC	3111	L	0.1
31	E	28	M	AB	3111	M	0.1
32	CP	28	L	AB	3111	M	0.1
33	E	20	L	NR	3111	M	0.3
34	P	20	L	NR	3111	L	0.4
35	E	20	L	NR	3111	M	0.2

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
36	CP	20	L	NR	3111	L	0.7
37	C	20	L	NR	3111	L	0.2
38	C	20	L	NR	3111	H	0.2
39	P	20	L	NR	1111, 3111	M	0.2
40	A	20	L	NR	3111, 3112	M	0.2
41	C	28	L	NR	4611	L	0.6
42	E	28	M	NR	4611	H	0.6
43	CP	28	M	NR	4611	M	0.6
44	C	28	L	ABC	4611	L	0.1
45	E	28	M	ABC	4611	M	0.3
46	CP	28	M	ABC	2211, 4311, 4611	L	0.9
47	C	0	L	D	2211, 4311, 4611	L	0.3
47	C	15	L	D	2211, 4311, 4611	L	0.2
48	E	15	H	A	2211	M	2.2
49	C	15	M	A	2211	L	0.6
50	C	15	M	A	2211	L	1.4
50	C	21	M	A	2211	L	0.3
51	C	21	L	ABC	2211	L	0.7
52	C	12	M	D	2211, 4111	L	3.8
52	C	17	M	D	2211, 4111	L	1.3
53	E	12	H	D	2211, 2221, 2222, 4111, 4611	H	6.6
54	E	0	L	ABC	2221, 2222	H	0.5
55	E	22	L	AB	2222, 4111	H	0.1
55	E	0	L	AB	2222, 4111	H	0.1
56	C	12	L	AC	2211, 4111	L	1.4
57	C	22	L	NR	2211	L	1.5
58	C	22	L	AB	2211	L	1.0
59	C	22	M	ABC	2211	L	4.9
60	E	25	M	AB	2211	M	0.9
61	E	25	L	ABC	2211, 3111, 4111	M	1.7
62	P	12	M	NR	2211	L	0.4
63	E	12	H	NR	2211	M	0.4
63	E	25	H	NR	2211	M	1.2
64	E	12	H	ABC	2211, 4111	M	4.0
64	E	25	H	ABC	2211, 4111	M	11.1

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
65	C	9	M	ABC	2211, 4111, 4211	L	3.8
65	C	0	M	ABC	2211, 4111, 4211	L	1.9
66	P	0	M	AC	2211, 4111	L	0.6
67	A	0	L	NR	4111	M	0.3
68	A	0	L	NR	3111, 4111	M	1.2
69	C	0	M	NR	3111, 4111	L	0.9
70	P	9	M	NR	4111	M	0.5
71	C	9	M	AB	3111, 3113, 4111	L	1.4
72	E	11	M	A	3111	M	0.5
73	E	23	M	A	3111, 3112	L	0.8
74	R	23	M	A	3111	H	0.3
75	R	23	M	NR	3112	H	0.1
76	P	23	L	NR	3112, 3113	M	0.2
77	E	11	H	ABC	3111, 3112	L	3.8
78	CP	11	L	A	3111	M	0.2
79	E	11	L	A	3111	H	0.5
80	E	11	L	A	3111	H	0.6
81	E	20	L	NR	3111	H	0.2
82	C	11	M	A	3111, 3112	L	5.1
83	C	20	M	AB	3111, 4111	M	0.2
84	C	10	L	ABC	4111	M	1.9
85	E	20	M	NR	3111	M	0.4
86	CP	15	M	D	4311	M	0.2
86	CP	0	M	D	4311	M	0.4
87	CP	15	M	D	2211, 4311	L	2.2
87	CP	0	M	D	2211, 4311	L	2.5
88	P	0	M	D	2211, 4311	L	2.0
89	E	0	M	ABC	2211	L	0.3
90	C	0	L	AC	2211	H	0.1
91	C	0	M	ABC	2211, 4311	L	2.2
92	E	0	H	ABC	2211, 4311	M	22.1
93	E	0	H	ABC	2211	M	5.0
94	E	21	H	AC	2211	M	0.7
94	E	0	H	AC	2211	M	1.2
95	E	12	H	ABC	2211	M	3.9

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
96	E	23	M	AB	2211	M	0.1
97	CP	23	M	ABC	2211	H	0.4
98	E	23	M	A	2211	M	1.3
99	C	4	L	ABC	2211, 4111	L	0.9
100	E	4	H	A	2211	M	3.1
101	A	0	M	A	4111	M	1.6
102	P	0	M	ABC	4111	M	1.1
103	R	0	M	NR	4111	H	0.5
104	A	0	M	AC	4111	M	0.5
105	R	0	M	ABC	4111	L	0.6
106	RPC	0	H	A	4111	H	0.7
107	A	9	M	A	4111	M	0.5
108	C	0	M	AC	3113, 4111	L	0.7
109	E	9	H	A	3111, 3112, 3113, 4111, 4211	M	0.7
109	E	0	H	A	3111, 3112, 3113, 4111, 4211	M	7.7
110	E	23	M	NR	3113	M	0.9
111	CP	23	M	A	3112, 3113	H	0.5
112	A	10	L	NR	3113	M	0.2
113	E	10	H	AB	2211, 3113, 4111	L	12.3
114	E	10	L	NR	4111	M	1.1
115	P	8	M	NR	4111	M	0.6
116	E	8	M	NR	2211, 4111	M	0.2
117	A	21	L	NR	4111	M	0.3
118	C	21	M	NR	2211, 4111	H	0.5
119	C	2	M	D	2211	M	2.1
120	P	2	M	A	2211	M	1.2
120	P	0	M	A	2211	M	1.4
121	E	0	M	AC	2211	M	0.8
122	E	0	L	AC	2211	M	0.2
123	CP	28	M	AC	2211	M	0.7
124	E	28	M	ABC	2211	M	0.5
125	P	23	L	ABC	2211	L	0.8
126	C	0	M	ABC	2211	L	1.9
127	P	0	M	AB	2211	M	0.2
128	P	0	M	ABC	2211	M	0.3

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
129	C	0	M	ABC	2211	H	0.2
130	E	4	M	NR	4111	H	4.6
131	C	4	M	ABC	2211, 4111	L	12.6
132	Av	0	M	A	4211, 4311	M	0.6
133	R	0	L	AC	4311	H	0.4
134	C	0	L	AB	4111, 4211	M	0.8
135	P	0	M	D	3113, 4111, 4211, 4311	L	5.6
136	R	0	H	AB	3113, 4111, 4311	H	1.0
137	E	0	H	ABC	4111, 4311	H	0.6
138	P	23	H	ABC	3112, 3113, 4311	L	0.3
138	P	0	H	ABC	3112, 3113, 4311	L	3.6
139	C	0	M	NR	4111, 4311	H	0.8
140	C	0	M	AB	4111	H	0.4
141	A	0	M	NR	4111, 4311	M	0.3
142	E	10	H	AC	2211, 3112, 3113, 4111, 4311	L	1.8
142	E	.	H	AC	2211, 3112, 3113, 4111, 4311	L	6.6
143	C	8	M	ABC	2211, 4111	L	1.0
143	C	0	M	ABC	2211, 4111	L	3.7
144	CP	0	M	ABC	3112, 3113	H	0.6
145	P	23	M	AB	3112, 3113	M	0.4
146	C	23	L	NR	3113	M	0.3
147	P	23	M	D	3113	M	0.4
148	E	8	M	A	3113	M	0.9
149	E	8	M	AB	2211, 3113	L	0.5
150	C	8	M	NR	2211, 3113	L	10.5
151	C	8	M	A	2211, 4111	L	0.5
151	C	10	M	A	2211, 4111	L	0.3
152	PEC	8	M	A	2211, 4111	L	0.5
153	C	8	M	A	4111	L	0.2
153	C	10	M	A	4111	L	0.1
154	P	10	M	A	4111	M	<0.1
155	E	8	M	NR	2211, 4111	M	1.5
156	C	8	M	NR	2211, 4111	L	1.6
157	E	8	M	NR	2211, 4111	M	1.4
158	P	8	L	A	4111	M	0.2

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
159	E	8	M	A	4111	M	0.2
160	C	8	M	AC	4111	L	0.2
161	C	8	M	AC	4111	H	0.2
162	E	8	M	A	4111	M	0.2
163	native willow	0	H	NR	2111, 2211	M	0.4
164	P	1	M	D	2111, 2211	L	3.4
165	C	1	M	AB	2211	L	0.1
166	P	1	L	D	2211	L	0.6
167	C	1	M	D	2211	L	1.7
168	C	1	M	AB	2211	L	1.6
169	C	5	M	D	2211, 2222	L	1.5
170	CP	2	H	A	2211	L	19.6
170	CP	2	H	A	2211	L	1.0
171	P	2	M	AB	2211	L	0.4
172	E	2	M	A	2211	L	1.6
173	P	2	M	A	2211	L	1.1
174	CP	0	M	A	2211	M	2.5
175	native oak	5	H	NR	2211, 2221, 2222	M	1.3
176	native willow	5	H	D	2211, 2221, 2222	M	5.4
177	P	0	M	D	2211	M	3.2
178	E	3	M	AB	2211	H	0.2
179	C	3	L	A	2211	M	0.6
180	E	3	L	D	2211	H	1.7
181	C	3	L	NR	2211	M	0.6
182	C	3	L	NR	2211	M	0.8
183	E	3	M	NR	2211, 3111	H	0.2
184	C	3	M	ABC	2211	L	6.9
185	P	3	L	NR	2211	L	0.5
186	C	3	M	NR	2211	M	1.1
187	P	3	M	NR	2211	M	0.2
188	C	3	L	NR	2211	M	0.8
189	C	3	L	NR	2211, 3111	M	0.9
190	P	3	M	NR	3111	M	0.1
191	P	3	M	NR	2211, 3111, 4111	M	1.3
192	C	3	L	NR	3111	M	0.3

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
193	P	3	M	NR	3111, 3114	M	0.2
194	E	3	M	NR	3111, 3114	H	0.4
195	E	3	M	NR	3111	H	0.4
196	C	3	L	NR	3111	M	1.0
197	C	3	L	NR	3111	M	0.3
198	E	3	M	NR	3111	H	0.2
199	C	3	L	NR	3111	M	0.6
200	C	3	M	NR	2211, 2211, 3111, 3114, 3211	M	0.7
201	E	6	H	NR	2211, 3111, 3211	M	5.9
202	E	3	M	NR	3111, 4111	M	1.7
203	P	3	M	NR	3111, 4111	M	0.3
204	C	3	M	NR	3111, 4111, 4311	L	7.2
205	P	3	M	NR	4311	L	0.2
206	E	3	M	NR	4111, 4311	M	2.2
207	C	3	L	NR	4311	M	0.4
208	C	3	L	NR	3111, 4111, 4311	M	0.6
209	C	6	L	NR	2211, 3111	M	0.4
210	C	6	L	NR	2211	M	0.6
211	C	3	L	NR	4111, 4311	M	0.9
212	P	3	L	NR	4111, 4311	M	0.1
213	C	3	L	NR	4111, 4311	M	1.1
214	P	3	L	NR	4111	M	0.1
215	C	3	L	NR	4111, 4311	M	4.4
216	C	3	L	NR	4111	M	0.2
217	C	3	L	NR	4111	M	0.6
218	C	3	L	NR	4111	M	0.2
219	C	3	L	NR	2211, 4111	M	0.2
220	C	3	L	NR	2211	M	0.2
221	C	3	L	NR	4111	M	1.4
222	E	3	H	NR	2211, 4111	M	1.7
223	C	3	L	NR	4111	M	1.3
224	C	3	L	NR	4111	M	0.2
225	C	3	L	NR	4111	M	0.7
226	C	7	L	AB	2211	L	0.3
227	P	7	L	A	2211	L	0.4

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
228	native willow	0	H	D	3114, 5000	M	1.1
229	C	0	L	A	3111, 3114	M	0.3
230	P	0	M	ABC	3111	M	0.5
231	P	0	M	A	3114	M	0.3
232	native willow	0	H	D	3111, 3114, 5000	M	1.4
233	CP	6	H	A	3111, 3114, 5000	M	0.1
234	E	6	H	ABC	3111, 3114, 5000	M	0.3
235	native freshwater marsh	0	H	D	2211, 3111, 3114, 3211, 5000	M	1.4
236	C	0	NR	A	4411	NR	0.1
237	C	0	NR	A	4411	NR	<0.1
238	C	0	NR	ABC	4411, 4611	NR	0.5
239	C	18	NR	ABC	4411	NR	0.5
240	E	18	NR	ABC	4411, 4611	NR	0.5
240	E	0	NR	ABC	4411, 4611	NR	0.7
241	C	0	NR	AB	4411, 4611	NR	0.5
242	C	20	NR	A	2111	NR	0.1
243	C	19	NR	AB	4611	NR	0.2
244	C	19	NR	NR	4611	NR	0.3
245	C	28	NR	AB	4411, 4611	NR	0.3
246	C	19	NR	NR	4611	NR	0.5
247	E	19	NR	AB	4611	NR	0.2
248	C	28	NR	AC	4611	NR	0.1
249	C	20	NR	NR	2111	NR	<0.1
250	C	23	NR	ABC	4611	NR	0.4
251	C	13	NR	AB	4611	NR	0.8
252	C	20	NR	A	2111	NR	0.1
253	E	20	NR	NR	2111	NR	0.1
254	P	20	NR	AB	2111	NR	0.1
255	P	20	NR	A	2111	NR	0.1
256	D	20	NR	A	2111	NR	0.2
257	Sy	20	NR	A	2111	NR	0.1
258	F	20	NR	A	2111	NR	<0.1
259	C	20	NR	A	2111	NR	0.1
260	C	20	NR	AB	2111	NR	0.2

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
261	P	20	NR	A	2111	NR	0.1
262	F	20	NR	A	2111	NR	0.1
263	C	0	NR	AB	4611	NR	0.3
264	P	20	NR	A	2111	NR	0.3
265	C	13	NR	A	4611	NR	0.5
266	P	20	NR	A	2111	NR	0.1
267	F	20	NR	A	2111	NR	0.2
268	C	19	NR	A	4611	NR	<0.1
269	C	23	NR	D	4611	NR	0.1
270	P	20	NR	A	5000	NR	0.1
271	P	20	NR	A	2111	NR	0.2
272	A	20	NR	AB	2111	NR	<0.1
273	A	0	NR	ABC	4411, 4611	NR	0.6
274	C	19	NR	A	4611	NR	<0.1
275	F	20	NR	A	1111	NR	0.8
276	P	20	NR	A	2111	NR	<0.1
277	C	20	NR	A	2111	NR	<0.1
278	P	20	NR	A	1111	NR	0.1
279	E	20	NR	A	5000	NR	0.1
280	C	19	NR	A	4611	NR	<0.1
281	P	20	NR	A	5000	NR	<0.1
282	E	0	NR	NR	2111	NR	0.3
283	F	20	NR	A	1111	NR	0.7
284	C	20	NR	NR	2111	NR	0.2
285	Me	24	NR	NR	4611	NR	0.1
286	C	20	NR	A	2311	NR	<0.1
287	F	20	NR	A	1111	NR	0.9
288	P	20	NR	A	2311	NR	<0.1
289	P	20	NR	A	2311	NR	0.1
290	C	23	NR	ABC	4611	NR	0.3
291	E	20	NR	A	2311	NR	<0.1
292	P	20	NR	NR	2111	NR	0.2
293	S	24	NR	A	4611	NR	0.1
294	E	0	NR	NR	2111	NR	0.3
295	D	20	NR	A	2311	NR	<0.1

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
296	C	28	NR	A	4611	NR	0.3
297	A	20	NR	NR	1111	NR	0.1
298	CP	13	NR	D	4511, 4611	NR	2.1
299	P	20	NR	A	1111	NR	0.1
300	P	24	NR	A	4611	NR	0.1
301	P	28	NR	ABC	4611	NR	2.2
302	C	0	NR	AB	4611	NR	0.1
303	C	28	NR	ABC	4611	NR	0.1
304	C	20	NR	NR	1111	NR	0.1
305	A	20	NR	NR	1111	NR	<0.1
306	S	24	NR	A	4611	NR	0.1
307	D	20	NR	NR	1111	NR	0.2
308	S	20	NR	NR	1111, 2111	NR	0.1
309	S	20	NR	NR	1111	NR	0.1
310	C	24	NR	NR	4611	NR	0.3
311	S	24	NR	A	4611	NR	0.3
312	E	20	NR	NR	1111	NR	0.1
313	Me	20	NR	A	1111	NR	0.1
314	C	28	NR	A	4611	NR	0.1
315	CP	20	NR	NR	3111	NR	0.2
316	E	20	NR	NR	1111	NR	0.2
317	C	28	NR	A	4611	NR	0.3
318	A	20	NR	NR	1111, 3111	NR	0.2
319	E	20	NR	NR	1111, 3111, 3112	NR	0.3
320	C	28	NR	A	4611	NR	0.4
321	P	20	NR	NR	3111	NR	0.1
322	P	20	NR	NR	1111	NR	0.1
323	C	20	NR	NR	3111	NR	0.1
324	C	24	NR	A	4611	NR	0.2
325	D	20	NR	NR	3111	NR	<0.1
326	D	20	NR	NR	3111	NR	<0.1
327	P	20	NR	NR	1111	NR	0.1
328	S	24	NR	A	4611	NR	0.1
329	P	20	NR	NR	3111	NR	0.5
330	E	25	NR	ABC	2211, 3111	NR	0.8

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
331	A	20	NR	NR	3111, 3112	NR	0.1
332	D	20	NR	NR	3111	NR	<0.1
333	C	20	NR	NR	3111	NR	<0.1
334	C	14	NR	NR	2211, 3111	NR	5.2
335	S	24	NR	A	4611	NR	0.1
336	C	20	NR	NR	3111	NR	<0.1
337	D	20	NR	NR	3111	NR	<0.1
338	C	20	NR	NR	3111	NR	<0.1
339	D	20	NR	NR	3111	NR	<0.1
340	C	20	NR	NR	3111	NR	<0.1
341	C	20	NR	NR	3111	NR	0.1
342	C	25	NR	NR	3111	NR	0.4
343	C	20	NR	NR	3111	NR	0.1
344	C	14	NR	NR	3111	NR	0.5
345	E	28	NR	NR	2211, 4611	NR	0.4
346	C	20	NR	NR	3111	NR	<0.1
347	E	20	NR	NR	3111	NR	0.1
348	S	20	NR	NR	1111, 3111	NR	0.2
349	C	20	NR	NR	3111	NR	<0.1
350	Me	20	NR	NR	3111	NR	0.4
351	C	14	NR	NR	2211, 3111	NR	0.3
352	S	20	NR	NR	1111	NR	0.1
353	D	20	NR	NR	3111	NR	0.4
354	P	20	NR	NR	1111	NR	0.3
355	E	20	NR	NR	1111	NR	0.1
356	D	20	NR	NR	3111	NR	<0.1
357	D	20	NR	NR	3111	NR	0.1
358	D	20	NR	NR	3111	NR	0.1
359	A	20	NR	NR	3111	NR	<0.1
360	A	20	NR	NR	3111	NR	0.1
361	D	20	NR	NR	3111	NR	0.1
362	C	20	NR	NR	3111	NR	0.2
363	A	0	NR	NR	3111	NR	0.1
364	P	20	NR	NR	3111	NR	0.1
365	D	20	NR	NR	3111	NR	0.1

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
366	A	20	NR	NR	3111	NR	0.2
367	P	14	NR	NR	2211, 4111	NR	1.7
367	P	25	NR	NR	2211, 4111	NR	0.1
368	E	11	NR	A	3111, 3112	NR	0.4
369	D	20	NR	NR	3111	NR	0.3
370	S	20	NR	NR	3111	NR	0.3
371	A	20	NR	NR	3111	NR	0.2
372	A	23	NR	A	4111	NR	<0.1
373	D	20	NR	NR	3111	NR	0.2
374	D	23	NR	A	4111	NR	<0.1
375	A	23	NR	NR	4111	NR	0.1
376	A	23	NR	A	4111	NR	<0.1
377	P	20	NR	NR	3111	NR	0.3
378	A	23	NR	A	4111	NR	<0.1
379	C	0	NR	D	4311	NR	0.3
380	Me	20	NR	NR	3111	NR	0.1
381	Me	23	NR	A	4111	NR	0.6
382	D	23	NR	A	2211, 4111	NR	<0.1
383	C	20	NR	NR	3111	NR	0.1
384	C	23	NR	A	4111	NR	0.1
385	P	0	NR	ABC	3111, 4111	NR	0.8
386	C	11	NR	A	3111	NR	0.1
387	Sy	23	NR	AC	2211, 4111	NR	0.2
388	CP	20	NR	NR	3111	NR	0.2
389	P	20	NR	NR	3111	NR	0.2
390	C	23	NR	A	2211	NR	0.1
391	A	20	NR	NR	3111	NR	0.1
392	D	20	NR	NR	3111	NR	<0.1
393	Sy	23	NR	AB	2211, 4111	NR	0.1
394	Me	20	NR	NR	3111	NR	0.3
395	D	20	NR	NR	3111	NR	<0.1
396	P	20	NR	NR	3111	NR	0.1
397	P	20	NR	NR	3111	NR	0.4
398	D	20	NR	NR	3111	NR	0.3
399	P	20	NR	NR	3111	NR	0.1

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
400	E	20	NR	NR	3111	NR	1.0
401	C	20	NR	NR	3111	NR	0.2
402	C	11	NR	A	3111	NR	0.2
403	Me	20	NR	NR	3111	NR	0.7
404	Me	20	NR	NR	3111	NR	0.1
405	C	0	NR	AC	4311	NR	0.1
406	Me	20	NR	NR	3111	NR	0.2
407	C	11	NR	NR	3111	NR	0.3
408	P	20	NR	NR	3111	NR	0.1
409	Me	20	NR	NR	3111	NR	0.1
410	E	20	NR	NR	4111	NR	0.2
411	Me	20	NR	NR	3111	NR	0.1
412	Me	20	NR	NR	4111	NR	0.6
413	D	20	NR	NR	3111	NR	<0.1
414	A	11	NR	NR	3111	NR	0.4
415	Me	20	NR	NR	3111, 4111	NR	0.8
416	C	20	NR	NR	4111	NR	0.5
417	C	23	NR	AC	3112, 3113	NR	0.6
418	P	23	NR	A	3112	NR	0.1
419	D	23	NR	NR	4111	NR	0.1
420	A	23	NR	A	3112, 3113	NR	0.3
421	A	8	NR	NR	3111, 4111	NR	0.2
422	P	23	NR	NR	4111, 4211	NR	0.5
423	C	23	NR	NR	4111, 4211	NR	0.1
424	C	23	NR	A	3113	NR	0.3
425	E	9	NR	A	4111	NR	0.1
426	C	1	NR	AB	2211	NR	0.9
427	C	23	NR	AC	3112, 3113	NR	0.8
428	A	0	NR	A	3112, 3113	NR	0.3
429	P	23	NR	AC	3112, 3113	NR	0.3
430	Me	3	NR	AB	2211	NR	0.7
431	C	3	NR	NR	2211	NR	0.2
432	C	3	NR	NR	2211	NR	0.2
433	C	23	NR	NR	2211	NR	0.1
434	E	3	NR	NR	2211	NR	0.1

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
435	P	0	NR	ABC	2211	NR	0.3
436	C	1	NR	AB	2211	NR	1.6
437	CP	23	NR	A	2211	NR	0.1
438	Av	23	NR	AB	2211	NR	0.1
439	C	23	NR	A	2211	NR	0.5
440	C	23	NR	A	2211	NR	0.1
441	P	23	NR	NR	2211	NR	0.1
442	C	23	NR	AB	2211	NR	0.1
443	CP	23	NR	A	3113	NR	0.1
444	C	23	NR	A	2211	NR	0.1
445	C	23	NR	A	2211	NR	0.1
446	C	23	NR	AB	2211	NR	0.2
447	C	23	NR	AB	2211	NR	0.1
448	C	23	NR	AB	2211	NR	<0.1
449	CP	1	NR	NR	2111, 2211	NR	5.0
450	A	23	NR	NR	3112	NR	0.1
451	CP	23	NR	AB	2211	NR	0.1
452	P	0	NR	A	2211	NR	<0.1
453	P	23	NR	AB	2211	NR	0.1
454	A	23	NR	A	3113	NR	<0.1
455	E	1	NR	NR	2211	NR	0.2
456	C	23	NR	A	2211	NR	0.2
457	P	23	NR	A	2211	NR	<0.1
458	A	23	NR	NR	3112	NR	<0.1
459	Av	23	NR	A	2211	NR	0.1
460	Av	23	NR	A	2211	NR	0.1
461	C	23	NR	AB	2211	NR	0.1
462	C	23	NR	AB	2211	NR	0.1
463	P	23	NR	ABC	2211	NR	<0.1
464	P	1	NR	NR	2211	NR	0.3
465	Sy	23	NR	A	3112	NR	0.2
466	P	23	NR	A	2211	NR	<0.1
467	C	23	NR	NR	2211	NR	0.1
468	E	1	NR	NR	2211	NR	0.6
469	P	23	NR	AB	2211	NR	<0.1

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
470	CP	23	NR	ABC	2211	NR	0.1
471	CPA	2	NR	AB	2211	NR	0.4
472	Av	23	NR	A	2211	NR	0.1
473	CP	23	NR	A	2211	NR	0.1
474	P	23	NR	A	2211	NR	0.1
475	P	23	NR	A	2211	NR	<0.1
476	C	1	NR	NR	2111	NR	0.1
477	E	8	NR	A	2211	NR	0.3
478	A	10	NR	AC	4111	NR	0.1
479	C	23	NR	AB	2211	NR	<0.1
480	A	23	NR	AC	2211	NR	0.1
481	P	23	NR	NR	2211	NR	0.1
482	CP	23	NR	A	2211	NR	<0.1
483	P	23	NR	A	2211	NR	0.1
484	C	23	NR	AC	2211	NR	0.1
485	C	8	NR	ABC	2211	NR	0.8
486	P	23	NR	A	2211	NR	0.1
487	P	10	NR	A	4111	NR	0.1
488	C	23	NR	A	2211	NR	<0.1
489	CP	2	NR	A	2211	NR	0.5
490	P	23	NR	A	2211	NR	<0.1
491	Av	23	NR	A	2211	NR	<0.1
492	E	2	NR	A	2211	NR	0.4
493	A	1	NR	NR	2211	NR	0.1
494	C	7	NR	A	2211	NR	0.1
495	A	0	NR	A	2211	NR	0.4
496	P	20	NR	C	2211	NR	0.7
497	C	0	NR	NR	2211, 3111	NR	0.1
498	C	0	NR	A	2211	NR	0.1
499	P	0	NR	A	2211	NR	0.2
500	C	0	NR	NR	4411	NR	0.1
501	A	20	NR	NR	3111	NR	0.8
502	E	20	NR	NR	3111	NR	0.2
503	E	0	NR	ABC	2211, 3111, 4111	NR	0.5
504	C	20	NR	NR	3111	NR	0.1

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
505	C	20	NR	NR	3111	NR	0.1
506	A	8	NR	NR	2211	NR	0.1
507	A	8	NR	ABC	2211	NR	0.5
507	A	0	NR	ABC	2211	NR	0.7
508	E	0	NR	ABC	2211	NR	0.1
509	C	20	NR	AB	2111	NR	0.1
510	P	20	NR	NR	2111	NR	0.4
511	Me	20	NR	NR	4111	NR	4.2
512	Me	10	NR	NR	4111	NR	0.5
513	C	3	NR	ABC	2211, 3111	NR	0.5
514	E	0	NR	A	2211, 3111	NR	0.3
515	C	0	NR	ABC	4411, 4611	NR	0.2
516	E	28	NR	NR	2211, 4611	NR	0.1
517	E	0	NR	AB	2211	NR	0.1
518	A	0	NR	AC	2211	NR	1.0
519	E	18	NR	ABC	4411, 4611	NR	2.8
519	E	0	NR	ABC	4411, 4611	NR	1.0
520	C	16	NR	NR	4611	NR	0.6
521	E	23	NR	ABC	4411, 4611	NR	0.1
522	CP	0	NR	D	4311, 4411, 4611	NR	0.8
523	P	20	NR	AB	3111, 3113, 4111	NR	0.6
524	CP	10	NR	A	3112, 3113	NR	0.6
525	C	1	NR	ABC	2211	NR	1.5
526	C	0	NR	ABC	2211	NR	0.4
527	Ww	23	NR	D	3112	NR	0.2
528	P	1	NR	D	2111, 2211	NR	2.1
529	C	0	NR	AC	2211	NR	0.2
530	P	0	NR	NR	2211	NR	0.4
531	[illegible]	0	NR	NR	2211	NR	0.2
532	[illegible]	0	NR	NR	2211	NR	0.5
533	P	0	NR	NR	2211	NR	0.2
534	E	7	NR	NR	2211	NR	0.1
535	S	5	NR	NR	2211	NR	0.2
536	P	0	NR	A	2211	NR	0.2
537	CP	0	NR	NR	2211	NR	0.6

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
538	A	5	NR	ABC	2211	NR	0.1
539	P	5	NR	C	2211, 2221, 2222	NR	1.6
540	P	5	NR	NR	2211, 2222	NR	0.1
541	P	0	NR	D	2211	NR	0.3
542	C	0	NR	NR	2211	NR	0.1
543	A	5	NR	NR	2211	NR	0.4
544	A	0	NR	NR	4111	NR	0.2
545	Ww	23	NR	C	3112	NR	0.1
546	Ww	23	NR	NR	3113	NR	<0.1
547	N	20	NR	A	fill	NR	<0.1
548	M	20	NR	NR	2111	NR	0.2
549	N	20	NR	AB	1111	NR	0.2
550	N	20	NR	AB	1111	NR	0.2
551	N	20	NR	NR	1111	NR	0.1
552	Co	20	NR	NR	1111	NR	0.1
553	PA	20	NR	NR	1111, 3111	NR	0.1
554	SDr	24	NR	A	4611	NR	0.1
555	SDr	24	NR	A	2211, 4611	NR	0.2
556	Ep	20	NR	NR	1111, 3111	NR	0.7
557	PE	20	NR	NR	3111	NR	0.1
558	Pi	20	NR	NR	3111	NR	0.1
559	N	20	NR	NR	3111	NR	0.1
560	N	20	NR	NR	3111	NR	0.1
561	N	20	NR	NR	3111	NR	0.1
562	N	20	NR	NR	3111	NR	0.2
563	N	20	NR	NR	3111	NR	0.1
564	Dr	20	NR	NR	3111	NR	0.1
565	Ce	20	NR	NR	3111	NR	0.1
566	N	20	NR	NR	3111	NR	0.1
567	CRA	11	NR	NR	3112	NR	0.2
568	PPo	23	NR	A	3113	NR	0.1
569	PEC	23	NR	AB	3112, 3113	NR	0.6
570	M	23	NR	AB	2211	NR	0.1
571	RC	8	NR	NR	4111	NR	0.2
572	M	23	NR	A	3113	NR	0.1
573	M	23	NR	A	2211	NR	<0.1

Table D-1. Continued

Stand Number[a]	Species[b]	Management Area[c]	Wildlife Rating[d]	Understory Sensitivity[e]	Soil-Geologic-Vegetation Unit[f]	Stand Vigor[g]	Acreage
574	CA	23	NR	A	2211	NR	<0.1
575	EA	0	NR	A	2211	NR	0.5
576	Dr	20	NR	NR	3111	NR	0.1
577	M	20	NR	NR	2111	NR	0.1
578	CAvM	23	NR	NR	2211	NR	0.1
580	G	20	NR	NR	2111	NR	<0.1
581	M	20	NR	NR	1111, 2111	NR	0.4
582	Ce	20	NR	NR	3111	NR	0.1
583	Dr	20	NR	NR	3111	NR	0.1
584	CT	0	NR	NR	4111, 4311	NR	0.2
585	O	20	NR	NR	3111	NR	0.3

[a] Stand Number: See Figure 3-4.

[b] Species: See Figure 3-4.

[c] Management Area: See Figure 5-2.

[d] Wildlife Rating:

H = high.
L = low.
M = Medium.
NR = not rated.

[e] Understory Sensitivity:

A = non-native plant species.
AB = mixed native and non-native grasslands, forbs, and herbs.
ABC = mixed native and non-native grasslands, forbs, herbs, trees, and shrubs.
AC = mixed native and non-native trees and shrubs.
BC = native trees and shrubs.
C = native trees and shrubs.
D = sensitive areas: wetlands or rare and endangered plant species.
NR = not rated.

[f] Soil-Geologic-Vegetation Unit: See Table 3-1.

[g] Stand Vigor:

H = high.
L = low.
M = medium.
NR = not rated.

Appendix E. Plan for Cultivation of Trees upon the Presidio Reservation

PLAN FOR THE CULTIVATION OF TREES

UPON THE

PRESIDIO RESERVATION.

ENGINEER OFFICE,
HEADQUARTERS DEPARTMENT OF CALIFORNIA,
Presidio of San Francisco, Cal., March 26, 1883.

Assistant Adjutant General,
Headquarters Department of California,
Presidio of San Francisco, Cal.

SIR:—I have the honor to submit a detailed plan for the cultivation of trees upon the Presidio Reservation.

I have given the matter considerable attention and treated it largely, because it is one of both importance and interest. The plan, although apparently so extensive, is perfectly feasible, by keeping up the accretion of small doings. Each season's work can be laid out beforehand, and the trees can be produced from seeds in unlimited numbers at very small cost. In the propogation of seeds and rearing of the young trees we cannot do better than to follow the plan in such successful operation at the Golden Gate Park of San Francisco. The trees there are raised from seed, which is planted in wooden boxes 1 ft. 6 in. x 2 ft. 6 in., and 5 inches deep. These boxes are kept, until the young trees are about 2 inches high, in glass frames, with sloping and sliding tops, each division to hold 4 boxes (about 3 ft. 2 in. x 5 ft. 2 in., inside measurement). The tops should slope towards the south, if possible. They are then removed (still in boxes) to a house 20 feet wide, with gable roof, the whole covered with laths nailed diagonally, with about half an inch between. This is to harden the young trees, which are taken from there and planted out.

There is another large glass house, 30 ft. x 100 ft.; but the chief gardener informs me the width is much too great, as the side benches are 6 feet wide and the centre one will be 12 feet, which is too great a reach for a man. He recommends that it ought to have been not over 17 feet, viz.:

Bench 3 feet—passage 2 feet—bench 6 feet—passage 2 feet—bench 3 feet.

The sashes in this house are fixed, and there is a ventilator running the whole length of each wall and one along the crest of the roof. The glass, wherever used, should be coated with lime wash (with plenty of white glue) on the outside.

Plans of the seed-boxes, glass-frames, and shade-house are submitted herewith.

The earth in the boxes should be richly prepared loam. The seeds should be sown on the surface, no matter what their size, and sprinkled over loosely with sawdust, as a substitute for the leaves and leaf-mold of the forest. Germination is produced by heat and darkness. After the growth is started the plant wants plenty of light. In the planting of flowers and vegetables, gardeners have a principle of covering a seed to a depth equal to its size or thickness. This will not apply to trees. Nature plants these seeds on the surface. A tree-seed planted too deeply will come up and the young plant may seem strong and vigorous, but it will never make so strong and lusty a tree as if Nature's conditions had been more carefully followed.

Where trees are planted in sand or loose sandy soil, the ground will need no preliminary preparation; loose sand can be protected from blowing by brush anchored in by sand spaded over the butts, but ordinary ground should be coarsely broken up with the plough and not harrowed. Furrows can then be laid out as guides and aids in the planting. It is found in the Golden Gate Park that by setting out in the rainy season, the necessity of watering the young trees is entirely avoided. In transplanting, the soil about the roots should first be thoroughly saturated with water and then preserved in a compact mass or ball, for removal to the new site. This is important. Gardeners have a fancy for shaking the earth entirely free from the roots of young plants in transplanting. This is radically wrong. It saves some trouble, but seriously checks growth, and incurs unnecessary risk. A gardener meets the difficulty he has created by skillful watering. By proper care and forethought, I do not think the trees will need much attention after being once set out, a systematic annual thinning out being about all that will be found necessary.

General Plan. (*See Map.*)

A large forest on each of the three principal ridges, connected by belts along the boundary fence and through the sand-drift between Presidio and Fort Point. One (No. 1) on Telegraph Hill, connecting with the two large areas of drifting sand on either side. Another (No. 2) on Presidio Hill, sweeping around from the bluff on the Fort Point road and crowning the ridge as far as the First Avenue gate. Another (No. 3) commencing at the First Avenue gate and taking in the drifting sand belt along the fence to the top of the ridge in the southwest corner of the Reservation, thence running down that ridge to where it runs out on the main road from the lower gate. Then a narrow irregular belt along the fence of the eastern boundary. Then cover the principal portion of the marsh. The main idea is, to crown the ridges, border the boundary fences, and cover the areas of sand and marsh waste with a forest that will generally seem continuous, and thus appear immensely larger than it really is. By leaving the valleys uncovered or with a scattering fringe of trees along the streams, the contrast of height will be strengthened. The view from the avenue in front of the officers' quarters at the Presidio should not be restricted towards the bay by trees. Scattered clumps of trees in the valley just in front can be introduced, but not so that they will grow up and impede the main view. These groups should be composed principally of trees and shrubs showing flowing outlines, and should be artistically arranged. They occupy the frontispiece of the picture and require skillful handling.

The Presidio is the central and vital point of the composition, and I have given it an imposing background of forest overlooking great stretches of rolling greensward. This forest is, further, so disposed that there are very few points from without where its true breadth at any point can be appreciated, and it will seem to be very much larger than it is.

In order to make the contrast from the city seem as great as possible, and indirectly accentuate the idea of the power of the Government, I have surrounded all the entrances with dense masses of wood. The entrance from First Avenue leads through a long belt of wood, with vistas across the valley to the east, to the point where the road rounds the point of the hill and displays the whole of the magnificent view of the bay below. This is treated so as to burst suddenly in view, and thus heighten the effect by contrast. The Central Avenue entrance leads through a long belt of wood with vistas of the city, Alcatraz Island, etc. The Lombard-street entrance is through a narrow belt of trees. The ground here is flat and suitable for military manœuvres, and should not be restricted by trees. The street-railroad entrance is through a mass of trees. Masses of trees should not be

introduced in close proximity to the Presidio. They would add considerably to the dampness, and thus render it less comfortable as a dwelling place. The great forest on the hill which encircles it to the windward will add very much to the comfort of this situation by modifying the force of the wind. It will probably prove an effectual wind-break for the Presidio. At the approach to the ocean on Telegraph Hill, the trees are so disposed as to develop the Pacific Ocean view suddenly, and thus heighten its effect. At (*a*) a beautiful mountain vista can be arranged. At (*b*) another mountain vista. At (*c*) a vista of Angel Island. But this subject can be better treated after the trees are partly grown.

This project is perfectly feasible, provided it be treated systematically and with forethought. It should be remembered that we are in the midst of a great and growing city; that the eyes of people of culture are upon us, and that it is within our power to treat this matter so as to win delight and approbation on the one hand, or contempt and derision on the other. If it be worth while to plant trees on the Reservation at all, they should be planted effectively, and not dumped into the ground by the thousand, at random. Opinions will vary as to what would be the most effective arrangements, but the variation will be within narrow limits; and there is a general coincidence of opinion concerning the leading points of good taste in such a matter. Furthermore, the question of tree planting is one of vital importance to the people of this locality, so that a well sustained and intelligent example will contribute to the material good of a great many people; and this I conceive to be a becoming thing for us to do in all cases where it is reasonably within our power. With the means at hand, and that will remain in hand from year to year, it is perfectly feasible to carry out this project. There is no hurry about it, and it can be done thoroughly and well.

In order to protect the young trees from grazing cattle, they should be fenced in. As much as can be easily planted and cared for in one season should be fenced in at a time. After the trees are once well started in growth they need no further care. Where sand wastes are treed, no cattle should be allowed to roam among the trees for a great many years, and, in fact, the whole of the tree plantations should be protected from them until they get to be of considerable size. The best and cheapest inclosure is wire fence, with lanes leading through the trees from one grazing ground to another.

Bancroft Library

Trees in masses should be planted very thickly, keeping in view the height they will attain in one year's growth, and preserving a distance between them about equal to their height. Rapid growing trees, like Eucalyptus, can be planted 6 to 8 feet apart. Those of slower growth, as near as 4 feet apart. There should be an annual thinning out, especially of the feeble, sickly, and ill-shaped plants; keeping the distance between trees about equal to their height, so that the whole ground about their roots will be reasonably shaded, as in nature. The products of this thinning can be disposed of as nursery stock, poles, firewood, timber, etc. Considerable of the work can be done by prisoners, but in any event it is perfectly certain that the operation will more than pay for itself. The principal difficulty in the way of treeing this Reservation is the wind; but fortunately the whole trouble lies in one direction. During a large portion of the year, westerly winds, of exceptional force, prevail. Furthermore, they are the strongest and most persistent just at the season when deciduous trees are growing and rapidly forming tender shoots. Hence it is doubtful whether they can be successfully cultivated, except in sheltered sites and among masses of other trees. In the outset, therefore, we are almost restricted to evergreen trees that continue their growth during the winter season. Experience has proved that the regions from which to draw are the Pacific Coast, Australia, and the south of Europe. This results from a certain

similarity of geographical conditions, and these lead me to the opinion that New Zealand, the table land of Mexico, and the high lands of British India, could also be resorted to. Returning to the wind difficulty, I have met it by placing wind-breaks on the sides of masses exposed to westerly winds. These are composed of trees that have been proved able to resist the winds here, together with an outlying belt of wiry shrubbery. The trees are composed of an intermingling of needle-leaved and pendant-leaved varieties, which form a combination best adapted to resist wind. In masses, the Eucalyptus globulus is a good wind-stay, after it has attained some height, but it grows so rapidly as to be slender and weak at first. It can be introduced with much effect among masses of other trees after they have attained a few years' growth. The long slender branches whipping in the wind are very effective. And this brings me to the subject of pruning. The pruner industriously cuts these branches off, thus reducing the power of the tree to resist the wind. Doubtless, trees of defective shape can be improved by pruning, but the matter requires more than ordinary skill and judgment, and I would strongly recommend that *all* pruning of trees on this Reservation be forbidden. The trees that are growing here now have been most horribly mutilated. The chances are that Nature can produce stronger and better looking trees than the average gardener. Even her homeliest and most irregular productions have the merit of being picturesque.

I submit herewith a contour plan of the Presidio Reservation, showing in irregular outline the proposed tree plantations. These are subdivided into minor numbered areas—the numbers referring to the following legend, in which are given directions for the trees to be planted in each numbered area. The trees are disposed, as much as possible, so as to take advantage of their well known requirements of soil and situation. An attempt has also been made to produce massive contrasts of light and shade in the colors of the foliage.

LEGEND.

Showing the kinds of trees to be planted in the numbered areas on the map.

(1). Pines (Monterey) and Eucalypti (globulus, rostrata) and Acacia latifolia, A. lopantha, A. decurrens, A. pycnantha.

Libocedrus decurrens.

The pines should form the great mass of trees on this space, with scattered groups of the Eucalypti and Acacias. The Eucalypti should be principally disposed along the crest of the ridge, in order to increase by their great height the effect of the height of the hill.

Along the front of (1), which overlooks the Presidio, and where it borders the road, scattering Dogwoods and bright flowering Acacias should be placed, to light up the dark mass behind, as seen from the Presidio. Eucalypti should not be set out here until the others are 2 or 3 years old. Plant solid, and then thin out.

(2). Monterey cypress and Acacia latifolia, A. decurrens, A. pycnantha.

Libocedrus decurrens.

The Cypress should form the great mass of the trees on this space, with the Acacias in scattered groups among it.

(3) and (5). A mass of Leptospermum bushes, with scattered clumps of Monterey cypress, Acacia latifolia.

(4). Eucalyptus marginata, E. resinifera, Acacia dealbata, A. melanoxylon, A. pendula, A. cunninghamii, with Photinia (red berries) in a large group near the road.

(6). Same as (1), except Redwoods planted thickly along the crest of the ridge. Dogwood scattered along the road.

(7). Redwood and Eucalyptus marginata, and Libocedrus decurrens, Calif. Chestnut Oak and Tan-bark Oak.

(8). Redwoods along crown of ridge, and wherever soil is not sand, with European Oak, Calif. Chestnut Oak, Dogwood (scattered singly), and Tan-bark Oak, in scattered groups among the Redwoods. Elsewhere, masses of White Birch, Libocedrus dec., Cedrela Australis, Riga Pine, and scattered groups of Acacia lopantha, A. melanoxylon, A. harpophyllha, A. pycnantha, A. homalophylla.

Monterey Pine and Syncarpa laurifolia (resists teredo).

Eucalyptus, E. marginata, E. melliodora, E. resinifera, E. viminalis.

(9). Monterey Pine, Riga Pine, Maritime Pine. (Monterey Pine thick along fence and road.)

Bushes of Leptosperum, Broom, Scotch, Beach Grass, to help hold the sand until the trees get up. Masses of White Birch, Pines, and Libocedrus dec., with scattered groups of Acacia lopantha, A. longifolia var, sophoroe, A. harpophylla.

(9*). Libocedrus decurrens, Monterey Pine.

(10). Monterey Pine thick along fence. Riga Pine, White Birch, Libocedrus d, in masses in the sand.

Bamboo all around the reservoir, Acacia around and below the reservoir dam, Melaleuca pauciflora, M. squarrosa (Australian Tea Tree).

Catalpa kaempferii, Catalpa speciosa.

On the hard ground small masses of Catalpa speciosa, Calif. Black Walnut, Eucalyptus marginata, E. melliodora, European Oak, Cedrela Australis.

In scattered groups, Acacia pendula, A. dealbata, A. decurrens, A. cunninghamii, Redwood, Big Trees, Tan-bark Oak, Cork Oak, Cal. Black Oak, European Oak, Cal. Chestnut Oak, Cal. Golden Leaf Chestnut, Madrona, Wild Black Cherry, Torreya Calif., Thujopsis Borealis, Calif. Great Red Alder, and the following Australian hardwood trees: Flindersia oxleyana (Ash), Syncarpa laurifolia (resists teredo).

(11). Along the fence and along the road, in a thick mass, Monterey Pine and Libocedrus decurrens, masses of White Birch, Riga Pine, Monterey Pine, with groups of Acacia lopantha, longifolia var, sophora, harpophylla, Eucalyptus marginata, rostrata, globulus, Catalpa speciosa, kaempferi. Along the front edge of the sand, in the hard ground, scattered Dogwoods, Acacia nemu (of Japan, red flowers), Photinia (red berries), California Tree Poppy.

(12). Redwoods, Libocedrus dec. Monterey Pine, Eucalyptus globulus, rostrata, viminalis. A dense mass.

(13). Redwoods and Big Trees, forming the mass with scattered groups of Eucalyptus amygdalina, viminalis, marginata, melliodora, resinifera, sideroplloia.

Along the border of the fence and inside, scattered Dogwood and Acacia dealbata, melanoxylon, cunninghamii, fragrans, nemu (of Japan).

If buildings should be desired in this locality the trees could be reduced to a narrow belt along the fence.

(14). A wind-break, 150 feet wide, of Monterey Cypress, Acacia latifolia, and Eucalyptus rostrata along the road. Behind them, Redwoods, in mass, with scattered groups of Madrona, European Oak, Catalpa speciosa, kaempferi.

(15). An irregular belt of bushes, about 50 to 100 feet wide, to form part of the wind-break. Wind very severe along this line. Bushes as follows: Masses of Leptospermum, with scattered groups of Photinia (red berries), Pittosporum in variety, Laurestinus.

(16). Redwoods, with belt of ornamental trees along road retained as they now are.

(17). Same as (14), with wind-break along crest of ridge.

(18). Redwoods and Big Trees, as shown in special preliminary report.

(19). Along the banks of the slough, Avicenia tomentosa (mangrove), Bamboo, and New Zealand Flax.

In the sand, Acacia harpophylla, Acacia longifolia var, sophoroe, Casuarina equisitifolia, Casuarina quadrivalvis, Melaleuca pauciflora, Melaleuca squarrosa, and other varieties of Melaleuca, Banksia integra (Coast Honeysuckle), Frenela actinostrobus, Frenela venucosa. In the sand and hard soils, Eucalyptus globulus, Eucalyptus rostrata, Batis maratima (a shrub), Maritime Pine, Monterey Pine.

(20). Masses of Monterey Pine, White Birch; Maritime Pine, Haleppo Pine, Cluster Pine, Scotch Fir, Eucalyptus globulus, and E. rostrata.

Along the beach, Arundo arenaria (Beech-grass), New Zealand Flax, Lupines, Acacia longifolia var, sophoroe, Yellow Scotch Broom.

(21). Same as (19).

(22). Same as (20).

(23). Shown on special sheet and legend.

(24). Leave trees as they are planted now.

(25). Shrubbery. Masses of Leptospermum, with scattered groups and single; Pittosporum in variety, especially flowering; Ceonothus (Calif. Lilac), Photinia (red berries), Laurestinus, Veronica (red and purple), Erica (flowering heath), Polygala (purple everbloom), Junipers, Escalonia rosea.

Bamboo on the arroyo near the causeway.

(26). Mass of Eucalyptus marginata, amygdalina, viminalis, melliodora, resinifera, obliqua.

Libocedrus decurrens, Cedrela Australis, Monterey Pine, with scattered Dogwood and Acacia fragrans on border;Bamboo along the arroya.

(27). Calif. Myrtle, Calif. Chestnut Oak, Wild Black Cherry, Cal. Black Walnut, Cal. Black Oak, Monterey Pine, Eucalyptus melliodora, E. resinifera, E. amygdalina, E. rostrata, E. Marginata.

(28). This is mostly drifting sand, very much exposed to the wind. Where barren, plant first with Beach-grass and seeds of Lupine. Also soaked Oats over the whole area. Then plant masses of Leptospermum levigatum (sand-stay bush), mixed with Maritime Pine, Monterey Pine, Monterey Cypress, Acacia longifolia var, sophoroe (this will grow right down to the beach), New Zealand Flax (near beach), Acacia harpophylla, Acacia latifolia, Riga Pine, Common Broom. Afterwards remove the bushes and replace with Pines, Monterey Cypress, and Acacias. Protect moving sand by brush, anchored down with sand shoveled over the butts.

(29). Masses of Monterey Pine, Riga Pine, Haleppo Pine, Cluster Pine, Libocedrus decurrens, Scotch Fir, with scattered groups of Acacia longifolia var, sophoroe, Acacia harpophylla, Acacia latifolia. Where difficulty arises in the sand, first plant Lupines, Beach-grass, Leptospermum levigatum.

(30). On border towards the sea, a wind-break, 150 to 200 feet wide, of Monterey Cypress, Monterey Pines (these do not do well indiscriminately mingled together—plant them in separate masses or groups), Acacia latifolia, Acacia pycnantha. After these are two or three years' growth, plant thickly among them Eucalyptus globulus.

Behind this, masses of Libocedrus decurrens, Calif. Chestnut Oak, Cal. Wild Black Cherry, Cal. Black Walnut, White Birch, with scattered groups of Madrona, Calif. Myrtle, Pittosporum, Acacia decurrens, A. dealbata, A. Melanoxylon, A. cunninghamii, A. pendula.

(31). Same as wind-break in (30).

(32). Masses of White Birch, Libocedrus decurrens, Haleppo Pine, Riga Pine, Monterey Pine, Scotch Fir, with scattered groups of Acacia pycnantha, A. lopantha, A. harpophylla.

Where sand drifts, treat it first as in (28).

(33). A mass of shrubbery to break up the wind. Leptospermum levigatum in large masses, with groups of Maritime Pine, Acacia lopantha, A. harpophylla, A. longifolia, Pittosporum in variety, Photinia (red berries), Laurestinus, Veronica (red and purple), Yellow Scotch Broom, Spanish Broom, Malva, with scattered Dogwood (Cal.), Banksia integra (Coast Honeysuckle).

(34). Libocedrus decurrens, Monterey Pine, Eucalyptus globulus.

The borders of tree masses should be irregularly undulating, and where exposed to view from thoroughfares, ornamental trees and shrubs, especially of the flowering sort, should be scattered about with apparent carelessness. Trees for this purpose: Norfolk Island Pine, Australian Palm (dracena), Grevillia robusta, Magnolia grandiflora, Pinus sabiniana, Acacia nemu (of Japan), Great Flowering Dogwood (of California), Acacia fragrans, Lawson's Cypress, Torreya Californica, Melaleuca in variety, Oleander, red, Pepper Tree, Flowering Almond, Pittosporum in variety.

The following bushes and vines: Cherokee Rose, Ceonothus (Calif. Lilac), Photinia (red berries), Pittospermum (flowering), Yucca, Laurestinus, Veronica, Purple everbloom bush (Polygala), Erica (heath), Junipers.

The guiding lines in the areas laid out for tree plantations are the crest of the ridges, the roads, and the boundary fences.

Special Legend for Space fronting Presidio.

Trees.

.... Cal. Laurel.
b. Bamboo.
E. Eucalyptus marginata, resinifera, melliodora, viminalis, siberiana.
m. Cal. Myrtle.
o. Chestnut Oak.
a. Acacia decurrens, dealbata, melanoxylon, pendula, cunninghamii.
a_1. Acacia pycnantha, latifolia, fragrans.
x. Groups. Madrona, Cal. Chestnut Oak, Myrtle.
a_n. Acacia nemu (flowering Japan).
a_m. Acacia latifolia, Pittosporum.
a_4. Acacia fragrans, Pittosporum.
p. Pinus insignis, Monterey Pine.
w. Monterey Cypress, Wind-break, Acacia latifolia.
l. Flowering Almond.
n. Araucaria, Norfolk Island Pine.
g. Grevillia robusta.
L. Pittosporum.
l. Lawson's Cypress.
d. Palm, Dracena Australis.
p. Pepper Trees.
c. Casuarina.
c_1. Cedrela Australis.
t. Torreya.
s. P. Sabiniana.
e. Eucalyptus marginata, maculata, viminalis, resinifera, amygdalina, obliqua, rostrata.
d_2. Dogwood (flowering).

Bushes.

..... Broom, Scotch, Spanish.
2. Red berries (Photinia).
3. Groups. Cal. Lilac, Leptosperm[illegible], Acacia fragrans, Roses.
4. Leptospermum.
5. Broom, Scotch.
6. Ceonothus, Cal. Lilac.
7. Purple everbloomer (Polygala).
8. Veronica.
10. Laurestinus.
11. Agave.
2. Red berries, Cherokee Rose.

Through the courtesy of Professor E. W. Hilgard, of the University of California, I have obtained an analysis of the Presidio soils, and valuable suggestions as to their treatment. That concerning subsoil plowing deserves especial attention, wherever the hard subsoil comes near the surface. I append his valuable letter in full. Very respectfully, your obedient servant,

W. A. JONES,
Major of Engineers.

UNIVERSITY OF CALIFORNIA,
COLLEGE OF AGRICULTURE,

Berkeley, April 5, 1883.

Major W. A. Jones, U. S. Engineers,
Presidio of San Francisco.

DEAR SIR:—I transmit herewith the results of the analyses of two of the soils from the Presidio Reservation, sent by you, in accordance with your letter of January 24th. The work has been delayed in consequence of unexpected business connected with the session of the Legislature.

On examination, I find that the two sandstone soils, Nos. 1 and 3, differ only in the proportion of vegetable matter; and, furthermore, that the serpentine soil and subsoil are also mainly derived from the same materials as the others, the serpentine contributing only a little of its powder to the mass, but nothing that would make the two soils differ in any essential respect, save that on the whole the serpentine soil must be considered somewhat poorer in the ingredients of plant-food.

The analyses show a full supply of potash and lime, the latter being less in the subsoil, however. On the other hand, phosphoric acid is quite deficient, both in the soil and subsoil, for instead of a minimum of at least between .050 to .060. This implies that the soil will do fairly for coniferous trees, but for such as usually grow in lowlands or other rich soils, would need help in the way of manure—say especially bone-meal. With the aid of that and water you can make anything grow on the soil, for it is otherwise of good composition, and of good physical properties. In working it, it is desirable not to turn up the subsoil,—e. g.: If plowed, let a turning plow go ahead, running say 6 or 8 inches deep, according to the depth of the dark-colored surface soil, and then let a regular "subsoil plow," which only stirs the subsoil without turning it up, follow in the same furrow. This will tend to preserve moisture during the dry summer, and give the roots a chance to go deep for it.

The soil is surprisingly different from that of the Golden Gate Park, being disposed to be heavy instead of excessively sandy; so the experience had there, so far as the soil is concerned, will not apply directly to the Presidio.

Very respectfully and truly,

(*Signed*) E. W. HILGARD,
Prof. Agr.

ANALYSES OF PRESIDIO SOILS.

	Sandstone soil.		Sandstone subsoil.	
Insoluble residue	78.135	81.593	70.224	75.756
Soluble silica	3.458		5.532	
Potash	.675		.590	
Soda	.080		.172	
Lime	.846		.399	
Magnesia	.780		1.221	
Br. ox. manganese	.053		.059	
Ferric oxid	5.[illegible]		7.268	
Alumina	5.[illegible]		9.737	
Phosphoric acid	.031		.011	
Sulphuric acid	.053		.022	
Organic matter and water	5.404		4.900	
	100.359		100.135	
Humus	2.284		.....	
Available inorganic	1.045		.....	
Hygroscopic moisture	6.023		9.411	

Appendix F. Important Forest Insects at the Presidio

Important Forest Insects at the Presidio

This appendix was prepared by Stephen G. Smith, consulting forester, in Ben Lomand, CA.

Dendroctonus valens, Red Turpentine Beetle

This insect attacks the base of injured, dying, or healthy trees or freshly cut logs and stumps of all pines and occasionally spruce, larch, and fir. Ordinarily, it is not considered an aggressive tree killer, but it does do considerable primary damage and so weakens trees, making them more susceptible to attack by other bark beetles. However, it sometimes causes sufficient damage to kill Monterey pines.

The adults are the largest bark beetles of this genus, measuring 0.25-0.375 inch in length. They are distinctly reddish in color. Their attacks are characterized by large, reddish pitch tubes. On burrowing under the bark, the beetles excavate irregular, longitudinal egg galleries between the bark and the wood. These galleries range from a few inches to several feet in length. The galleries are more or less packed with frass, and eggs are laid in groups or masses at intervals along the sides. The larvae feed out through the inner bark in mass formation, producing a cavity ranging from a few square inches to a square foot or more between the bark and wood. These chambers are often filled with a resinous liquid that apparently has no injurious effect on the developing broods. Transformation to the adult stage occurs within pupal cells constructed in the boring dust of the brood chamber or in short mines along its margin.

This beetle is seldom of serious importance. Should control measures become necessary, the broods can be destroyed by removing the bark from the infested areas of stumps and trees. For the protection of individual park or shade trees, the damage can be halted by cutting out the attacking beetles with a knife or chisel as soon as the pitch exudations indicate their presence. Successful control also has been obtained by injecting carbon disulfide into the galleries. *D. valens* has been found on both Monterey and cluster pines in San Francisco.

Phoracantha semipunctata, Eucalyptus Longhorn Borer

The eucalyptus longhorn borer is a serious pest of eucalyptus trees. Originally found only in Australia, it has spread to New Zealand, Asia, Africa, Europe, South America, and recently to the United States. Since its discovery in southern California in 1984, the beetle has spread from Orange County to Los Angeles, San Bernardino, Ventura, Riverside, and San Diego

Counties. In 1989, sightings of the beetle were confirmed in Contra Costa and Alameda Counties. The northern California populations are believed to have developed from beetles imported to northern California independently of the older, southern California populations. Importation of eucalyptus lumber products and transportation of eucalyptus firewood are the primary mechanisms of long-distance beetle movements.

The adult is a blackish-brown beetle approximately 1 inch long. Each wing cover is rough; bears a zigzag-shaped, cream-colored marking on the front; and is smooth with a single, similar-colored spot at the rear. The antennae of male beetles are noticeably longer than the body; those of the female are about the same length as the body. These characteristics caused the beetle to acquire the name "longhorn".

Larvae are roundheaded borers that grow to be 1.5 inches long. They feed in and under the bark of eucalyptus, producing tunnels that may be more than an inch in width and several feet in length. These tunnels are densely packed with a very fine, granulated sawdust, which is often visible in cracks in the bark. Adults begin to emerge in April and are active throughout the spring and summer months. Females lay 200-300 eggs under loose bark in clusters of 20-30 that hatch in 2 weeks.

The insects prefer to lay their eggs in trees stressed by drought or soil nutrient deficiency, or in recently cut or fallen eucalyptus logs and branches. Healthy trees usually produce enough sap (called gum) to drown newly hatched larvae. Once cut, no species of eucalyptus is immune to attack. Egg laying occurs quickly, generally within 2 days of cutting, and a generation of beetles can be produced within 3 months.

Control methods include:

- burying or chipping infested wood or covering it with tarps for at least 6 weeks;
- pruning trees and cutting wood during the winter and early spring when adult beetles are inactive;
- quarantining eucalyptus firewood and chips produced in infested areas; and
- watering periodically during droughts.

Phloeosinus cupressi and *P. cristatus*, Cypress Bark Beetle

These insects are, at times, very destructive to Monterey and other cypresses in California. Besides killing many trees outright, they mine and kill the twigs of ornamentals, making them unsightly. They often work in conjunction with cypress canker to cause tree mortality. Keeping trees healthy is the best protection against cypress bark beetle attacks; direct control is practical only for isolated infestations.

Appendix G. Important Forest Diseases at the Presidio

Important Forest Diseases at the Presidio

This appendix was adapted from the Golden Gate Park Forest Management Plan (California Department of Forestry 1980).

Trunk and Root Diseases

Armillaria mellea (Armillaria Root Disease)

Hosts: A wide variety of plants are attacked by this fungus, including most trees and shrubs as well as herbaceous plants and vegetables. In San Francisco, it is found on Monterey pine, cluster pine (*P. pinaster*), Monterey cypress, California live oak, eucalyptus, *Paulownia fargesii*, satsuma plum, and azalea. Symptoms resembling those of *A. mellea* have been found on other trees and shrubs, but these have not been positively identified.

Range: This fungus is widespread and is common throughout most forested areas. It is present in both the temperate and tropical regions and occurs throughout California.

Symptoms: Decline in vigor of the host as a whole or certain branches is usually the first external indication of the disease. Leaves may turn yellow and drop prematurely. Branches may die back. Some plants, such as Douglas-fir, often produce a heavy crop of small fruit known as a survival crop the year previous to dying. Pines usually have an abnormal resin flow from the root collar, sometimes so great that the litter and soil are compacted into a hard crust. Other plants may exude gums or sticky juices.

Removal of the bark near the crown of the affected plant usually exposes whitish-yellow mycelium plaques, made up of one to many fan-like mycelial felts 0.5-1.5 inches in diameter (size of felt depends somewhat on size of host). Flattened, string-like, brown to black rhizomorphs or "shoestrings" often form under the bark on the roots and root collar and extend out into the soil adjacent to severely infected roots. The rhizomorphs can be mistaken for tree rootlets, but they branch differently and are filled with whitish mycelial strands instead of wood fibers.

The fruiting bodies, yellow capped mushrooms covered with dark brown scales, when present, offer positive identification. The yellow or honey-colored cap is 2-5 inches across, and the yellow to brown stalk, which usually has a ring just below the gills, is 3 inches or more in length. The mushrooms grow on the lower trunk of dead or dying trees, on stumps, or on the ground near infected roots. They are short-lived, annual fruiting bodies that may occur singly, but they more commonly occur in groups of several to 100 or more. The mature mushrooms

release many tiny spores, produced on their gills, that are windborne to other infection sites such as stumps or woody debris. Infection of living trees by spores has not been demonstrated.

A. mellea is most commonly spread to living trees by the rhizomorphs or by root contact. In younger trees, the pathogen advances rapidly through the inner bark to the root collar, where it girdles and kills the tree. In older trees, this advance through the inner bark proceeds much more slowly. Like most diseases, *A. mellea* favors a weakened host. Drought favors the disease. Moving plants outside their natural range increases their probability of attack. Injuring roots while transplanting makes them more susceptible to infection.

A. mellea is a facultative parasite; that is, it is normally saprophytic but capable of changing to a parasitic life. This is particularly true when the fungus emerges from oak stumps and roots.

Control: As with many similar diseases, direct control is rarely possible. *A. mellea* is sensitive to drying and grows most rapidly under wet conditions. Heavy watering should be avoided.

Preventive measures that maintain conditions favorable for rapid and vigorous tree growth will usually keep damage by this disease to a minimum and are generally more practical than direct control. Even when trees begin to show signs of infection, proper fertilization will usually prolong the life of the tree for many years. When the base or roots of a tree have been wounded, the exposed wood should be treated with a disinfectant such as bordeaux paste.

Chemicals have been used most effectively to treat contaminated soil that is to be planted. Certain fumigants have been particularly effective; for example, carbon disulfide has been used for many years in California to control *A. mellea* in citrus orchards.

Another precaution is to remove old stumps and as many of their roots as possible. Also, when a tree falls, breaks, or is cut, the stump with its roots should be removed. These recommendations are made because *A. mellea* can build up rapidly in the dead wood of the stumps and roots. The fungus appears to become especially virulent when it is cultured in oak stumps and roots.

Fomes applanatus (Shelf Fungus)

Hosts: The fungus is usually found on old logs, stumps, and the exposed wood of living broadleaf trees. It is occasionally found on conifers. In San Francisco, it is found frequently on coast live oak, acacia, and eucalyptus.

Range: *F. applanatus* is found throughout North America. In Golden Gate Park it is the most frequently observed fungus.

Symptoms: The fruiting bodies are usually found near the ground, though occasionally they arise above 25 feet. Corky when fresh, rigid when dry, the fan-shaped bracket is brown and woody on the upper surface and white on the lower pore surface, which turns brown when bruised. Fruiting bodies vary in size from 3 to 36 inches across. More than one fruiting body is often found on a single stump.

Fruiting bodies are produced abundantly on dead wood and less frequently on living trees, where they always develop from wounds. In older trees, the fungus rots the roots and heartwood and can cause premature falling of the trees. The decay caused by this fungus appears white to straw colored, mottled and stringy, soft and spongy.

Control: No control is known for *F. applanatus*, but any procedures to minimize the wounding of trees are beneficial. When pruning the branches of hardwoods, the application of a disinfectant to the exposed surface is recommended. It might be advisable to remove trees supporting sporophores because they already have varying degrees of heart rot. In addition, the removal of the infected trees would eliminate a source of infecting spores.

Coryneum cardinale **(Cypress Canker)**

Hosts: Both wounded and unwounded tissues are sites for infection.

Range: This disease is absent from the natural range of Monterey cypress (the Monterey Peninsula). It is, however, a problem on Monterey cypress (and has been found on Coast redwood) outside of its natural range. One tree in Golden Gate Park was found to be infected with this fungus.

Symptoms: Fading and death of twigs, branches, and tops of trees are the most conspicuous symptoms of infection. Resin flow usually accompanies canker development, and as the killed bark tissues dry out, a sunken area develops. The presence of cankers is a sure indication of infection. Cypress bark beetles are often associated with, and hasten the death of, infected trees.

Dark, irregularly shaped, blister-like fruiting bodies 0.3-1.5 millimeters in size are produced and break through the bark of the dead tissues. Cankers grow more rapidly along a branch or trunk than around it, and they usually have a length-width ratio of about 3:1. Infected trees or branches 2-3 years old may be killed within a year. Larger branches or trunks of infected trees may survive for 5-10 years.

Control: Cankers should be cut out and destroyed, followed immediately by spraying of the surrounding host trees with a fungicide; particular care should be given to spraying the twigs, branches, and trunks thoroughly.

Fusarium subglutinans **(Pine Pitch Canker)**

Hosts: Pine pitch canker is a damaging fungus disease of pine trees, especially Monterey pine. Other susceptible pines include Bishop, Scotch, ponderosa, digger, Coulter, Italian stone, aleppo, sugar, knobcone, eldarica, and Jeffrey.

Range: This fungal disease, which was first reported in California in 1986, has been found in portions of Alameda, Monterey, Santa Clara, Santa Cruz, San Mateo, and San Francisco Counties. It also occurs in the southeastern states from Virginia to Florida and west to Texas. Pine pitch canker primarily affects highway, park, and residential plantings. The disease has not been found in natural Monterey pine stands.

Symptoms: The first visible symptom of the disease is a color change in the tree. Foliage on the infected canopy branch tips fades from the normal dark green to lime green to yellow and red before needle drop. This change may occur within one growing season or may extend into the next year.

Branch cankers often exude pitch that falls and forms a whitish crust on the green needles below. The infected wood under the bark is resin-soaked and amber in color.

Cankers may form on the main stem of a tree. Like branch cankers, stem cankers cause large amounts of pitch to flow freely down the tree trunk. These stem infections are often hidden by branches and thus hard to see.

Pine pitch canker can occur on tree roots in lawns and heavily trafficked areas. Roots damaged by lawn mowers or cars are readily infected by the fungus.

The disease appears to be more severe where Monterey pine is densely planted. However, canker infections can be found in less crowded areas and even on isolated trees. Tip, branch, and stem infections probably occur through wounds created by insects and storm damage. Severely infected trees may eventually be killed by insects such as bark beetles and borers.

Control: To help reduce the spread of pine pitch canker, plant pathologists currently recommend the following treatments:

1. Prune infected branch tips or entire branches. After each cut, disinfect cutting tools with aerosol spray disinfectant or 70% alcohol solution.

2. Do not prune diseased trees during windy or rainy periods.

3. Cut down all trees with cankers on the trunk.

4. Do not move diseased wood outside the infected area.

5. Do not replant with any species of pine.

Peridermium harknessii **(Western Gall Rust)**

Hosts: This fungus has only two known stages, pycnial and aecial. It occurs on most of the two- and three-needled hard pines throughout their range in the western United States. It has been found on 22 species of pine in the West, but only on Monterey pine in San Francisco. Neither telial nor uredial stages of the rust are known.

Range: *Peridermium harknessii* is common in western North America from Mexico to Alaska and eastward to Nebraska. It has been reported on Jack pine as far east as Quebec. It is widespread throughout California and is especially prominent on Monterey pine in both its natural range and throughout the state, wherever it has been planted. It is just as prevalent on lodgepole pine throughout the Sierra Nevada and southern Cascade Ranges.

Symptoms: The rust first appears as a small swelling in the bark of a limb or stem. This usually becomes visible about 1 year after infection occurs. The swelling causes the cells to divide rapidly, resulting in woody galls, which, at first, are rather soft. These later harden and become more decay resistant than normal wood. The penetration of the mycelium into the cambium spreads around the limb or bole about as fast as it elongates, giving the infected area a globose or ball-shaped form. Aecial pustules, bearing the aeciospores, are produced in the spring and early summer of the second or third year after infection and usually every year thereafter so long as the rust lives, which may be one more year or for a century or two. Aecia develop under bark scales on old cankers and appear at maturity as little white mounds of irregular shape on galls or at the edge of cankers. The aecial pustules rarely emerge when the bark becomes thickened.

P. harknessii is an obligate parasite (requiring living host cells), its pycnial and aecial stages occurring on two- and three-needled pines. Apparently, infection occurs throughout the summer on the younger bark (generally on the current season's bark) directly from aeciospores. No alternate host (telial and uredial stages) has yet been found.

Usually galls live only a few years, because when aecia are produced the host bark is disrupted to the point that it dies, thus killing the twig, limb, or stem on which it grows. Trunk galls on young trees usually prove fatal. Limb galls, unless adjacent to the bole, do little damage as they kill only the one limb or the portion distal to the gall. Heavy damage may occur in young stands and plantations, but this is rare. When it does occur, it is confined to small areas (a few acres at most).

New cankers frequently cause the infected wood to become impregnated with resin and actually strengthen the wood; however, the fungus kills the wood and prevents further growth in the vicinity of the canker. The wood above and below the canker grows normally, but often the wood on each side of and opposite the canker grows more rapidly, forming callous tissue. This, in turn, often causes a broadening of the canker and in many cases results in a slight bend or crook in the bole at the point of the canker. After many years, the lack of growth on the face of the canker leaves a depression in the bole that causes it to weaken.

Control: Gall rust can be fairly well controlled by removing the cankers as they appear. To remove a limb canker, the limb should be severed about 6 inches from the canker on the proximal side. Bole cankers in young trees can be cut about 6 inches below the canker. A limb will turn up in a year or two and form a new leader.

Polyporus schweinitzii (Velvet Top Fungus)

This disease is also known as "red-brown butt rot". It causes a cubical rot of the heartwood of both roots and butt of living trees and may continue developing in dead trees, logs, and stumps.

Hosts: It is usually found on conifers but occasionally on hardwoods. It has been recorded on *Abies, Larix, Pinus, Pseudotsuga, Thuja, Tsuga,* and *Taxus* species as well as on *Betula, Halesis, Prunus, Quercus,* and *Eucalyptus*. *Polyporus schweinitzii* was found on Monterey pine at two locations in Golden Gate Park.

Range: The fungus is widespread throughout Europe, Asia, and North America. It is most prevalent along the Pacific coast.

Symptoms: The annual fruiting bodies, which develop most abundantly during moist weather in the late summer and fall, are found on the butts of infected trees issuing from old wounds or on the ground nearby, coming up from a decayed root. On the tree, the sporophore is a thin bracket, and frequently two or more brackets grow one above the other. When the sporophore is on the ground and viewed from above, it is circular in shape and sunken in the center, tapering to a short, thick stalk. When fresh, the upper surface is velvety, concentrically zoned, and reddish-brown in color with a light yellow-brown margin. The undersurface is dirty green and turns red-brown when bruised. When old and dry, sporophores become corky and have a deep red-brown or blackish-brown color. Infection occurs largely through basal wounds, particularly as a result of fire scars and vandalism.

In the advanced stage of rot, the wood is yellow-brown to red-brown in color (depending on the host), brittle, and breaks into large cubes that can be easily crumbled into a fine powder on drying. Thin, crust-like layers of mycelium that are easily mistaken for resinous crusts are formed in the shrinkage cracks.

Control: No control for *P. schweinitzii* is known. When an infected tree is found, the entire tree, including its stump, should be removed. This eliminates a new source of infecting spores.

Agrobacterium spp. (Crown Gall)

Hosts: This bacterium is commonly found on ornamentals of the rose family and especially on plants of the genus *Prunus*.

Range: The disease is worldwide in distribution. It has been found in Golden Gate Park, occurring on a variety of species of oak, eucalyptus, and myoporum.

Symptoms: This disease is caused by a bacterium. Galls varying from the size of a walnut to a football develop on roots, and occasionally on stems of ornamentals, as well as on trunks of some trees.

A. tumefaciens is not usually considered as a problem or threat to trees, but can be harmful to ornamentals. Injuries to shrubs or trees, such as wounds caused by lawn mowers or vandals, can increase the likelihood of a crown gall formation.

Control: The disease is controlled by avoiding injury to roots, preventing waterlogging of the soil, destroying severely diseased plants, and pruning off aerial galls which are loosely attached to stems (i.e. not surrounding the stem). Before planting in infected soil, roots of ornamentals can be dipped in copper fungicide. Antibiotics, such as bacitin or streptomycin, are useful for reducing infection. A bacterium is now being used as a control measure to compete with *A. tumefaciens* for food.

Heart Rots of Trunk and Limb

Fomes pini (White Pocket Rot)

This is a heartwood rot known as red ring rot, white pocket rot, pecky rot, honeycomb rot, red heart, or white speck.

Hosts: In San Francisco, this fungus is found on Monterey pine. Douglas-fir, spruce, larch, true firs, pines, and most other coniferous species are also susceptible. It is also known to occur on birch, hawthorn, and maple.

Range: The fungus is found worldwide. In the western United States, it is considered to be the most damaging heart rot organism.

Symptoms: This disease often occurs singularly on isolated trees. The best indicator of the disease is its perennial, woody fruiting body. These fruiting bodies do, however, vary in shape, size, and texture. They appear thin, shell-shaped to hoof-shaped, 1-12 inches long, 0.5-4 inches wide, and 0.25-5 inches tall. The upper surface is usually furrowed concentrically and dark brown to blackish in color. The lower pore surface is rusty-brown with circular to maze-like pores. A velvety margin often separates the two surfaces. Several fruiting bodies may be present on a single tree, most commonly arising from knots or branch stubs. Open wounds are rarely affected. By the time the sporophore appears, the heart rot has advanced about 10 feet both up and down the bole.

The decay causes a discoloration of the heartwood. In pines, a reddish or pink color is present. The advanced stages generally appear as a few to many elongated, spindle-shaped, pointed pockets or cavities aligned parallel to the grain and separated by apparently sound wood. The wood often becomes infiltrated with resin. The decay is confined to the heartwood but may attack living sapwood after the heartwood rot is well advanced.

Control: In parkland situations, the removal of affected trees is advised. This will curtail the number of spores present for further infection.

Polyporus basilaris (Cypress Heart Rot)

Hosts: Monterey cypress (*Cupressus macrocarpa*) is the primary target of this disease.

Range: The disease occurs in natural stands in California and nearly every area where Monterey cypress has been planted along the Pacific Coast.

Symptoms: *Polyporus basilaris* causes a brown cubical pocket rot in the butts and lower boles of Monterey cypress. The pockets are sharply delineated from adjacent firm wood. In the advanced stages of decay, the pockets coalesce to form masses of rot with thin strips of firm wood scattered through the mass. The small (1-2 inches across) conks are variable in shape, imbricated (overlapping), and bracket-like where well developed. The conks are tough, leathery, and dirty grayish to blackish when dry. One to several fruiting structures may be present, and these usually arise from branch stubs. The entrance of the fungus is thought to be through dead branches. In general, cypress trees 60-70 years and older are severely infested, but trees less than 26 years old are practically rot-free.

Control: No direct control is known at present to reduce the spread of the fungus. Dead branches should be pruned and large, older, and weakened trees should be removed. It is always good practice to prune lower limbs on the trees while they are small, which allows the knot to heal over quickly. This helps to prevent *P. basilaris* attacks and alleviates the problem of pruning larger, heavier branches in the future.

Polyporus sulphureus (Sulfur Fungus)

This fungus causes a brown cubical rot of the heartwood of living hardwoods and conifers, occasionally killing living sapwood.

Hosts: Plants affected by this fungus belong to the genera *Abies, Acer, Castanea, Eucalyptus, Fraxinus, Gleditsia, Juglans, Larix, Liriodendron, Picea, Pinus, Prunus, Pseudotsuga, Quercus, Robinia, Schinus, Tamarix, Tsuga, Ulmus, Celtis,* and *Fagus*.

Range: The fungus is common throughout southern Alaska, southern Canada, and the United States. It was found in Golden Gate Park on a fallen eucalyptus tree and on an open wound of a living Monterey pine.

Symptoms: The sporophores, when fresh, are soft, fleshy, and moist, with a bright orange-red upper surface, brighter at the margin, and a brilliant sulfur-yellow underneath. When old, they are hard, brittle, and chalky or dirty white in color. The annual shelf-like sporophores, containing pores in its undersurface, are conspicuous and frequently overlap one another in clusters of 2-20 or more. Infection occurs through dead branch stubs and wounds. This fungus produces conidia as well as basidiospores.

Control: There is no known control for this fungus. It is recommended that infected trees be removed to reduce the source of infecting spores.

***Fomes igniarius* (False Tinder Fungus)**

This is a white trunk rot and is destructive of many of its hardwood hosts. The decayed area is bounded on the outside by conspicuous dark zones or black lines. A single conk of average size indicates a rot column of 15 linear feet or more in the heartwood.

Hosts: Hosts of this plant are hornbeam, hop-hornbeam, birch, chinquapin, dogwood, cascara, manzanita, maple, madrone, *Adenostoma*, pear, beech, ash, walnut, poplar, oak, willow, and elm. It has been reported one or more times on *Picea, Prunus, Sambucus, Sassafras,* and *Xanthoxylon*.

Range: This fungus has been noted on oaks and eucalyptus in Golden Gate Park. It exists practically worldwide. The decay is a delignifying rot of the general type. As a result, the interior of the trunk or of the larger branches is reduced to a soft, spongy, whitened mass.

Symptoms: The hard, woody, thick perennial conks are usually hoof-shaped, but sometimes shelf-like, and they may attain a width of 8 or more inches. The upper surface is grayish-black to black, dull or shiny, at first smooth, but becoming rough and cracked with age. The undersurface is brown with the mouths of the tubes small and circular in outline. The context or interior of the conk is rusty-brown and shows many layers of tubes, those in the older layers being conspicuously stuffed with white. Normally, one tube layer is formed each year. The conks usually issue from knots or occasionally from wounds. On dead, down trees, the conks are sometimes thick crusts. Typical punk knots may appear at branch stubs, showing rusty-brown punky substance when chopped into.

Control: No effective control is known for this fungus. Removal of infected trees is desirable.

Fomes pinicola **(Red Belt Fungus)**

The name reflects the blackish-red margin of the sporophore.

Hosts: It is common on wood of gymnosperms and has occasionally been found on angiosperms. It was found on a Monterey pine log in Golden Gate Park.

Range: *F. pinicola* has been found from New Brunswick to North Carolina, west to California and Alaska, and in Mexico and Haiti. It is distributed throughout the north temperate zone.

Symptoms: The sporophore is a sessile, woody, hoof- to shelf-shaped perennial that may attain a width of 2 feet but usually varies from 2 to 10 inches. The upper surface is often covered with a reddish, resinous layer that may persist at the margin, becoming dry, and varying in color from grayish to black, hairless, and grooved with age. The pore surface is yellowish-white and, when fresh, darkens when bruised.

The fungus, a saprophyte, is the most common destroyer of dead coniferous timber. It can be responsible for the rapid deterioration of merchantable timber killed by windthrow, insects, fire, and other agents. It also causes heart rot in living trees. *F. pinicola* produces a reddish-brown crumbly mass with a tendency to break into cubes. Prominent mycelial felts develop in the shrinkage cracks.

Control: There is no practical control of this fungus. It can be kept to a minimum by removing all stumps and tree trunks when a tree succumbs from any cause.

Needle Diseases

Lophodermium pinastri **(Pine Needle Cast)**

This needle disease has been found on 24 pine species and some hybrids.

Hosts: In California, *Lophodermium pinastri* has been found on knobcone, digger, ponderosa, Jeffrey, lodgepole, whitebark, western white, Monterey, sugar, and Coulter pines. It has been found on Monterey pine in San Francisco.

Range: This needle cast is widely distributed. It has been found from India to Russia as well as in Denmark, Sweden, Scotland, Austria, Germany, and Italy. It ranges throughout most of Canada as well as the United States. It has been found on nine pine species in California.

Symptoms: The hysterothecia or fruiting structure is dull to shiny black and grows on the needle surface. On most pines, the symptoms are observable in one to several longitudinal

sections of the needle and are bound in by heavy, black lines. The leaf breaks readily along elliptic and subacute lines.

Infected needles on ponderosa and Jeffrey pines often remain on the tree and turn gray, giving the tree the "Old Gray Beard" appearance. The fruiting structures first appear on 3-year-old needles, and the fungus rarely if ever becomes even a weak parasite. Infected needles may remain on some trees for 10-15 years.

Citation

California. Department of Forestry. 1980. Golden Gate Park forest management plan. Sacramento, CA.

Appendix H. Concepts for Restoration of Native Habitats at Forest Removal Sites on the Presidio of San Francisco

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Concepts for Restoration of Native Habitats at Forest Removal Sites on the Presidio of San Francisco

INTRODUCTION AND OBJECTIVES

The objective of this report is to provide restoration concepts that can be directly applied to the restoration of native habitats at forest removal sites on the Presidio of San Francisco. Criteria used to determine which forest stands will be removed are provided in Chapters 4 and 5. Sites proposed for forest removal are shown on Figure H-1. The appropriate native plant community to restore at forest removal sites was determined based on the presumed vegetation occurring at the site historically and specific site conditions.

The determination of the type and distribution of historical native plant communities was based on soils, geology, and existing vegetation. The methods used for this analysis are described in Chapter 2. The historical vegetation distribution at the Presidio is shown on Figure H-2. Site conditions that determined the habitat type to restore included soil type, amount of disturbance, remnant native vegetation on site, and adjacent native vegetation. The relationship between forest stands to be removed and existing native vegetation is indicated on Figure H-3.

Restoration concepts for the following six native plant communities are discussed in this appendix:

- dune scrub,
- serpentine grassland,
- serpentine chaparral,
- coastal prairie,
- coastal scrub, and
- coast live oak woodland.

Descriptions of these habitats are provided in Chapter 3. These native habitats will be restored at specific forest removal sites (Figure H-3). The habitat restoration sites presently support stands of planted and naturalized Monterey pine, Monterey cypress, coast redwood, eucalyptus, acacia, and other non-native ornamental species. A list of native plant species known to occur at the Presidio is provided in Table H-1. This list includes the plant community in which each species occurs and the dominant species within communities. This table serves as a guide to indicate the native species available at the Presidio for propagation material and appropriate for restoring each plant community.

Table H-1. Native Species for Habitat Restoration (Species Already Present at the Presidio)

	Northern Foredune	Central Dune Scrub	Northern Coastal Bluff Scrub	Northern Coastal Scrub	Coastal Terrace Prairie	Serpentine Grassland	Serpentine Chaparral	Freshwater Seep	Coastal Freshwater Marsh	Central Coast Live Oak Riparian Forest	Central Coast Arroyo Willow Riparian Forest	Central Coast Riparian Scrub	Coast Live Oak Woodland
Abronia latifolia	D	X											
Abronia umbellata	D	X											
Acaena pinnatifida var. *californica*			X	X	X							X	
Acer macrophyllum										X			
Acer negundo var. *californicum*										X			
Achillea millefolium	X	X	X	X	X	X	X						X
Adiantum jordanii						X				X			
Aesculus californica										X			X
Agoseris aparigioides					X	X							
Agrostis exarata						X							X
Agrostis pallens													X
Allium dichlamydeum			X			X	X						
Alnus rubra										X	X	X	
Ambrosia chamissonis	D	X											
Amsinckia menziesii var. *intermedia*		X	X	X	X								
Amsinckia spectabilis		X			X					X			X
Anaphalis margaritacea		X	X	X	X								X
Angelica hendersonii			X	X									
Aphanes occidentalis			X	X	X					X			X
Arabis blepharophylla			X	X	X								
Arabis glabra			X		X								
Aralia californica										X	X	X	

Table H-1. Continued

	Northern Foredune	Central Dune Scrub	Northern Coastal Bluff Scrub *	Northern Coastal Scrub	Coastal Terrace Prairie	Serpentine Grassland	Serpentine Chaparral	Freshwater Seep	Coastal Freshwater Marsh	Central Coast Live Oak Riparian Forest	Central Coast Arroyo Willow Riparian Forest	Central Coast Riparian Scrub	Coast Live Oak Woodland
Arctostaphylos hookeri var. *ravenii* (s)							D						
Artemisia californica		X		X			X						
Artemsia douglasiana						X		X		X	X	X	
Artemisia pycnocephala	D	X											
Asarum caudatum										X			X
Aster chilensis		X	X	X	X	X	X						
Aster radulinus													X
Athyrium filix-femina													X
Atriplex leucophylla	X	X											
Baccharis pilularis	X	D	X	D	X		D			D[u]			D[u]
Berberis pinnata													X
Brodiaea elegans					X	X							
Brodiaea terrestris var. *terrestris*					X	X	X						X
Bromus carinatus		X	X	X	D								X
Bromus carinatus var. *maritinus*		X			X	X							
Calandrinia ciliata					X	X							
Calystegia occidentalis			X	X		X	X						
Calystegia subacaulis			X	X		X	X						
Camissonia cheiranthifolia	X	X											
Camissonia contorta	X	X											
Casmissonia micrantha	X	X											
Camissonia ovata		X			X								X
Cardamine oligosperma									X	X		X	X

Table H-1. Continued

	Northern Foredune	Central Dune Scrub	Northern Coastal Bluff Scrub	Northern Coastal Scrub	Coastal Terrace Prairie	Serpentine Grassland	Serpentine Chaparral	Freshwater Seep	Coastal Freshwater Marsh	Central Coast Live Oak Riparian Forest	Central Coast Arroyo Willow Riparian Forest	Central Coast Riparian Scrub	Coast Live Oak Woodland
Cardamine californica													X
Cardionema ramosissimum	X	X											
Carex brevicaulis		X		X	X								X
Carex densa				X				X					
Carex obnupta	X	X			X			X			X	X	
Carex subbracteata					X			X					X
Carex tumulicula					X			X					X
Castilleja affinis		X	X	X									
Castilleja wightii		X	X	X									
Ceanothus thyrsiflorus							D		X		D[u]	X	D[u]
Ceanothus thyrsiflorus var. *repens*			X	D			D						
Centaurium davyi					X								X
Chenopodium californicum	X	X	X										
Chlorogalum pomeridianum			X	X	X	X	X						X
Chlorogalum pomeridianum var. *aivaricatum*		X	X	X	X	X							X
Chorizanthe cuspidata	X	X											
Circuta douglasii								X	X		X	X	
Cirsium andrewsii			X				X	X					
Cirsium occidentale		X											
Cirsium quercetorum		X	X	X	X								X
Clarkia franciscana (s)						X	X						
Claytonia perfoliata	X	X	X	X	X	X	X	X		X	X	X	X

Table H-1. Continued

	Northern Foredune	Central Dune Scrub	Northern Coastal Bluff Scrub	Northern Coastal Scrub	Coastal Terrace Prairie	Serpentine Grassland	Serpentine Chaparral	Freshwater Seep	Coastal Freshwater Marsh	Central Coast Live Oak Riparian Forest	Central Coast Arroyo Willow Riparian Forest	Central Coast Riparian Scrub	Coast Live Oak Woodland
Clematis ligusticifolia										X	X	X	
Conyza canadensis										X	X	X	
Cornus sericea										X			X
Corylus cornuta var. *californica*										X			X
Crassula connata				X	X	X							
Croton californicus	X	X	X	X	X								
Cryptantha leiocarpa	X	X											
Cynoglossum grande											X		X
Danthonia californica		X	X	X	D	X	X						
Daucus pusillus		X	X	X	X	X							X
Deschampsia cespitosa									X				
Deschampsia elongata					X				X				X
Dicentra formosa								X		X			
Dichelostemma capitatum				X	X	X							X
Dichelostemma congestum		X			X	X	X						X
Dichondra donnelliana				X				X					
Distichlis spicata									X				
Disporum hookeri										X			X
Dryopteris arguta										X			X
Dudleya farinosa		X	X	X									
Eleocharis acicularis								X	X				
Elymus glaucus					X	X	X						X
Epilobium brachicarpum					X								X
Epilobium ciliatum ssp. *watsonii*			X	X						X	X		

Table H-1. Continued

	Northern Foredune	Central Dune Scrub	Northern Coastal Bluff Scrub	Northern Coastal Scrub	Coastal Terrace Prairie	Serpentine Grassland	Serpentine Chaparral	Freshwater Seep	Coastal Freshwater Marsh	Central Coast Live Oak Riparian Forest	Central Coast Arroyo Willow Riparian Forest	Central Coast Riparian Scrub	Coast Live Oak Woodland
Equisetum hyemale var. *affine*										X		X	
Equisetum telmateia										X		X	
Ericameria ericoides	X	D		X	X								X
Erigeron glaucus	X	X	X										
Eriogonum latifolium	D	X	X	X			X						
Eriophyllum staechadifolium var. *artemisiaefolium*	X	D	X	X			X						
Erysimum franciscanum	X	X											
Eschscholzia californica	X	X	X	X	X	X	X						X
Festuca rubra	X	X	X	X	D	X							
Fragaria chiloensis	X	X	X										
Fragaria vesca										X	X		
Fritillaria affinis					X	X							X
Fritillaria lanceolata					X	X							X
Galium aparine					X	X							
Gilia capitata var. *chamissonis*		X				X							
Gnaphalium purpureum		X	X	X		X							
Gnaphalium ramosissimum		X		X									
Gnaphalium stramineum								X					
Grindelia hirsutula var. *maritima* (s)			X			X	X						
Grindelia stricta									X				
Helenium puberulum								X		X	X		

Table H-1. Continued

	Northern Foredune	Central Dune Scrub	Northern Coastal Bluff Scrub	Northern Coastal Scrub	Coastal Terrace Prairie	Serpentine Grassland	Serpentine Chaparral	Freshwater Seep	Coastal Freshwater Marsh	Central Coast Live Oak Riparian Forest	Central Coast Arroyo Willow Riparian Forest	Central Coast Riparian Scrub	Coast Live Oak Woodland
Heracleum lanatum		X	X	X									
Hesperevax sparsiflora		X				X	X						
Hesperolinon californicum		X			X	X	X						
Hesperolinon congestum (s)						X	X						
Heteromeles arbutifolia			X	X			D			X			D[a]
Hordeum branchyantheruim					X	X		X					X
Hordeum depressum					X	X		X					
Iris douglasiana		X	X	X	X								X
Iris longipetala			X	X	X								X
Juncus balticus								X	X	X			
Juncus bufonius					X			X					
Juncus effusus								X	X	X	X	X	
Juncus falcatus var. *falcatus*								X	X	X	X	X	
Juncus lesueurii								X	X	X	X	X	
Juncus mexicanus					X	X							
Juncus patens								X	X	X	X	X	
Juncus phaeocephalus								X	X				
Koeleria macrantha					X	X	X						
Lasthenia californica						X							X
Lasthenia chrysostoma					X	X	X						
Lathyrus vestitus													X
Layia platyglossa					X	X	X						
Lessingia germanorum		X											

Table H-1. Continued

	Northern Foredune	Central Dune Scrub	Northern Coastal Bluff Scrub *	Northern Coastal Scrub	Coastal Terrace Prairie	Serpentine Grassland	Serpentine Chaparral	Freshwater Seep	Coastal Freshwater Marsh	Central Coast Live Oak Riparian Forest	Central Coast Arroyo Willow Riparian Forest	Central Coast Riparian Scrub	Coast Live Oak Woodland
Leymus triticoides				D	X	X		X					X
Leymus X vancouverensis (Hybrid between *L. mollis* and *L. triticoides*)	X	X											
Ligusticum apiifolium				X	X					X			
Lilium pardalinum								X		X		X	
Linaria canadensis	X	X											
Lomatium dasycarpum					X	X	X						
Lomatium utriculatum					X	X							X
Lonicera hispidula				X			X			X			X
Lonicera involucrata var. *ledebourii*				X						X			X
Lotus scoparius	X	X	X	X			X						
Lotus strigosus			X	X			X						
Lotus wrangelianus		X	X	X	X								
Lupinus albifrons	X	X	X										
Lupinus arboreus		D	X	X									
Lupinus biocolor		X			X								
Lupinus chamissonis	D	D											
Lupinus nanus		X			X								
Lupinus variicolor	X	X											
Luzula comosa					X								X
Lythrum hyssopifolium								X					
Marah fabaceus	X	X	X	X	X								X
Melica californica					D								X
Melica imperfecta			X	X	X	X	X						X

Table H-1. Continued

	Northern Foredune	Central Dune Scrub	Northern Coastal Bluff Scrub	Northern Coastal Scrub	Coastal Terrace Prairie	Serpentine Grassland	Serpentine Chaparral	Freshwater Seep	Coastal Freshwater Marsh	Central Coast Live Oak Riparian Forest	Central Coast Arroyo Willow Riparian Forest	Central Coast Riparian Scrub	Coast Live Oak Woodland
Melica torreyana			X	X									
Microseris bigelovii	X	X	X			X							
Microseris douglasii						X							
Mimulus aurantiacus		X	D	D			X						D[u]
Mimulus guttatus								X	X	X	X	X	
Monardella villosa var. *neglecta*			X			X	X						
Myrica californica			X	X						X		D	X
Nassella lepida			X		D	D	X						X
Nassella pulchra			X		D	D	X						X
Navarretia squarrosa						X							
Oemleria cerasiformis						X							
Oenanthe sarmentosa								X	X				
Oenothera elata var. *hookeri*	X	X											
Orobanche uniflora								X					
Osmorhiza chilensis						X							X
Perideridia kelloggii					X	X							
Phacelia californica		X	X			X							
Phacelia distans				X									
Phacelia malvifolia		X	X	X									
Phacelia ramosissima var. *ramossisima*		X			X								X
Piperia elegans		X		X									
Pentagramma triangularis			X	X		X							X
Plantago erecta		X				X	X						

Table H-1. Continued

	Northern Foredune	Central Dune Scrub	Northern Coastal Bluff Scrub *	Northern Coastal Scrub	Coastal Terrace Prairie	Serpentine Grassland	Serpentine Chaparral	Freshwater Seep	Coastal Freshwater Marsh	Central Coast Live Oak Riparian Forest	Central Coast Arroyo Willow Riparian Forest	Central Coast Riparian Scrub	Coast Live Oak Woodland
Plantago maritima	X	X				X							
Plantago subnuda			X					X	X				
Poa douglasii	D	X											
Polygonum paronychia	X	X											
Polygonum amphibium var. *emersum*								X	X				
Polypodium californicum		X	X	X	X								X
Polypodium scouleri			X	X		X	X						
Polystichum munitum				X									X
Polystichum imbricans var. *imbricans*				X									X
Potentilla anserina ssp. *pacifica*								X	X				
Potentilla gracilis				X	X								X
Prunella vulgaris var. *lanceolata*					X			X		X		X	X
Pteridium aquilinum var. *pubescens*		X	X	X	X					X			X
Quercus agrifolia		X[a]							D				D
Ranunculus californicus					X	X	X						X
Rhamnus californica		X	X	X						X		X	X
Ribes sanguineum var. *glutinosum*				X									X
Rorippa nasturtium-aquaticum								X	X				
Rosa californica				X			X			X		X	
Rubus ursinus		D	D	D	X		X			D[u]		X	D[u]

Table H-1. Continued

	Northern Foredune	Central Dune Scrub	Northern Coastal Bluff Scrub *	Northern Coastal Scrub	Coastal Terrace Prairie	Serpentine Grassland	Serpentine Chaparral	Freshwater Seep	Coastal Freshwater Marsh	Central Coast Live Oak Riparian Forest	Central Coast Arroyo Willow Riparian Forest	Central Coast Riparian Scrub	Coast Live Oak Woodland
Rumex salicifolius								X					
Salix lasiolepis			X							X	D	D	
Salix lucida											X	X	
Salix lucida ssp. *lasiandra*											X	X	
Sanicula arctopoides					X	X							
Sambucus racemosa				X						X		X	X
Sanicula bipinnatifida					X	X							X
Sanicula crassicaulis				X	X	X							X
Satureja douglasii				X									X
Scirpus americanus								X	X				
Scirpus californicus									X				
Scirpus cernuus									X				
Scrophularia californica		X	X	X		X		X		X		X	X
Sidalcea malvaeflora		X			X	X							X
Silene verecunda var. *verecunda*		X											
Sisyrinchium bellum					X	X	X						X
Solanum douglasii							X				X		X
Solanum umbelliferum							X					X	X
Solidago spathulata	X	X	X										
Spiranthes romanzoffiana								X	X				
Stachys ajugoides				X	X			X		X			X
Stachys bullata					X			X		X		X	X
Symphoricarpus albus var. *laevigatus*										X			

Table H-1. Continued

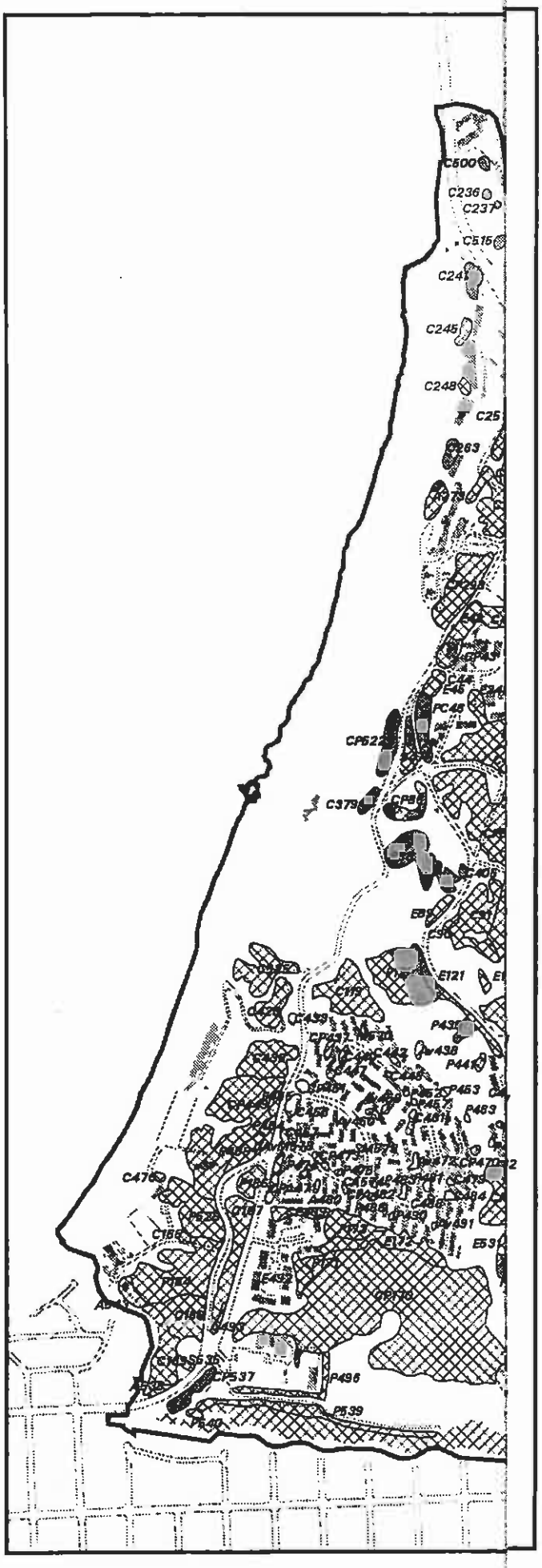
	Northern Foredune	Central Dune Scrub	Northern Coastal Bluff Scrub *	Northern Coastal Scrub	Coastal Terrace Prairie	Serpentine Grassland	Serpentine Chaparral	Freshwater Seep	Coastal Freshwater Marsh	Central Coast Live Oak Riparian Forest	Central Coast Arroyo Willow Riparian Forest	Central Coast Riparian Scrub	Coast Live Oak Woodland
Tanacetum camphoratum	X	X											
Toxicodendron diversilobum		D	D	D	X		X			D[u]			D[u]
Trifolium depauperatum					X	X		X		X			X
Trifolium wormskioldii		X	X	X	X			X	X			X	X
Triphysaria floribunda						X							
Trillium ovatum										X			
Triteleia laxa			X	X	X	X							X
Uropappus lindleyi					X	X	X			X			X
Urtica dioica ssp. *holosericea*			X	X				X		X			X
Veronica americana								X	X	X			
Vicia americana ssp. *americana*					X			X		X			X
Vicia gigantea		X	X	X									
Viola adunca								X		X			
Vulpia octoflora		X			X								
Wyethia angustifolia		X				X							X

Note: This table includes only native species known to occur at the presidio based on Jones & Stokes Associates (1990) and National Park Service unpublished data. Species native to California but not locally native to the San Francisco Presidio were not included. Native species that occur in disturbed habitats were not included.

D = dominant species in habitat, globally or locally
X = species present in habitat, not part of the dominant cover

* = some on serpentine soils.
s = restricted to serpentine soils.
[a] = short stature, multitrunked form of *Quercus agrifolia* is locally dominant in central dune scrub.
[u] = understory dominant

FIGURE H-1. FOREST STANDS PROPOSED FOR REMOVAL



FOREST STANDS

A	BLACK ACACIA
Av	ACACIA VERTICILLATA
C	MONTEREY CYPRESS
Ca	CASUARINA
Ce	CEDAR
D	DATE PALM
Dr	DRACAENA
E	EUCALYPTUS
F	FAN PALM
G	GIANT SEQUOIA
M	MYOPORUM
Me	MIXED EVERGREENS
N	NEW ZEALAND CHRISTMAS TREE
O	COAST LIVE OAK
P	MONTEREY PINE
Pi	PITTOSPORUM
Po	POPLAR
R	REDWOOD
S	STONE PINE
Sy	SYCAMORE
T	TOYON
Ww	WEEPING WILLOW

Stands proposed for removal and restoration to native vegetation

Other historic and landscape stands

Stand numbers 1 to 235 from McBride, 1988.
Stand numbers 236 to 585 from Jones & Stokes Associates.

Scale 1" = 1000'

0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

20-Nov-95

premov-f.eml

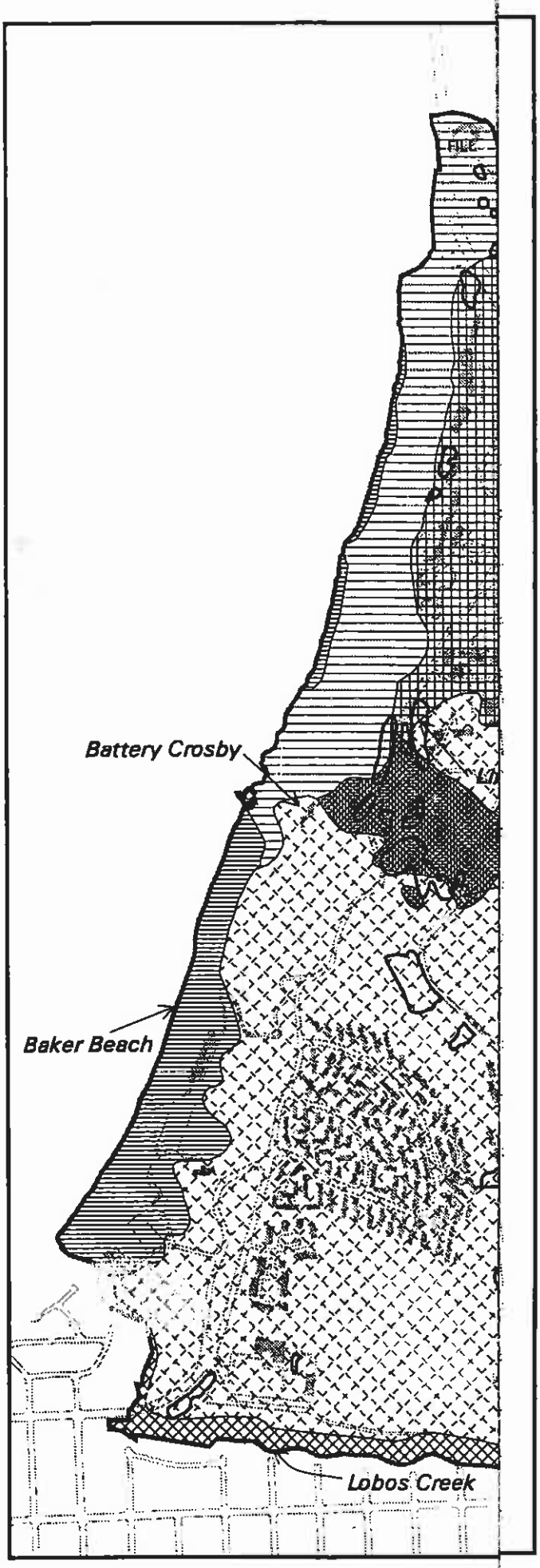
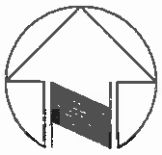


FIGURE H-2. PROBABLE PREHISTORIC NATIVE VEGETATION COMMUNITIES OF STANDS TO BE REMOVED

PREHISTORIC VEGETATION

- Central Coast Arroyo Willow Riparian Forest and Live Oak Riparian Forest
- Central Dune Scrub
- Coast Live Oak Woodland and Northern Coastal Scrub
- Coastal Freshwater Marsh
- Coastal Terrace Prairie
- Coastal Terrace Prairie and Northern Coastal Scrub
- Northern Coastal Bluff Scrub, Northern Coastal Scrub, and Serpentine Chaparral
- Northern Coastal Salt Marsh
- Northern Foredune
- Open Water
- Serpentine Grassland and Serpentine Chaparral
- Stands Proposed for Removal



Scale 1" = 1000'

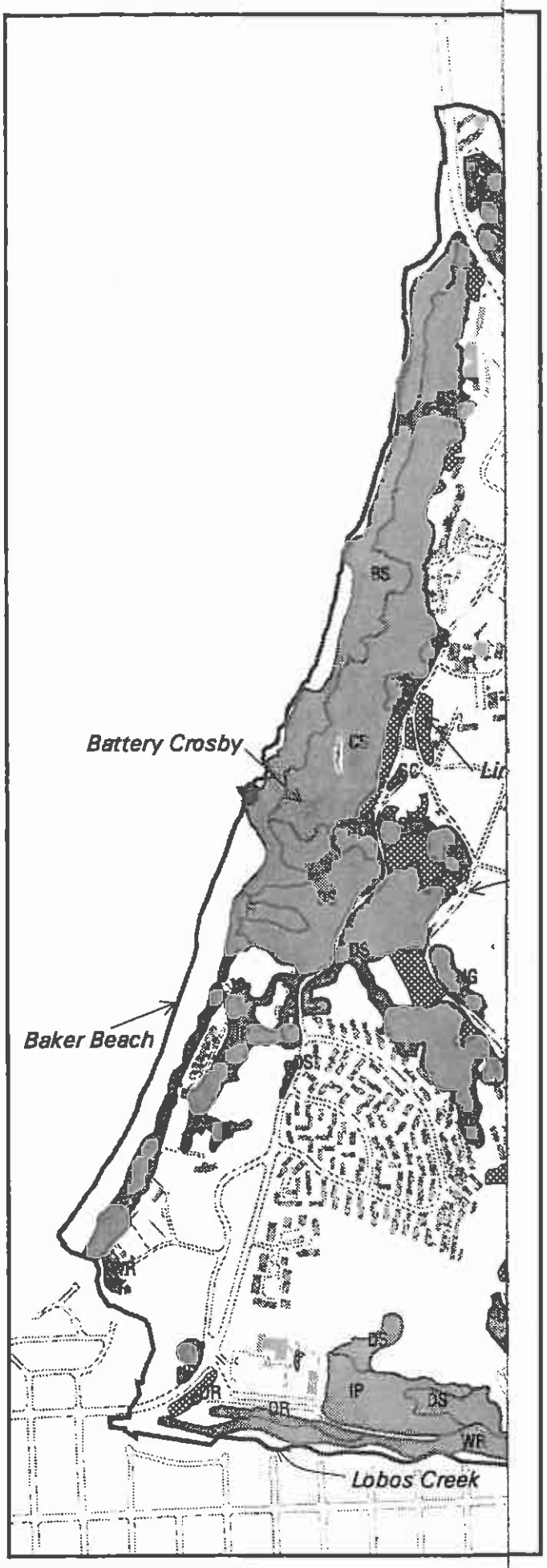
0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

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FIGURE H-3. FOREST STANDS TO BE REMOVED AND EXISTING NATURAL VEGETATION



Stands Proposed for Removal

Native Vegetation Communities

PLANT COMMUNITIES

F	Foredunes
DS	Dune Scrub
BS	Bluff Scrub
CS	Coastal Scrub
CP	Coastal Prairie
SP	Serpentine Prairie
SC	Serpentine Chaparral
IP	Ice Plant Mats and Non-Native Grasses on Dunes
NG	Non-Native Grassland
FM	Freshwater Marsh
OR	Live Oak Riparian Forest
WR	Arroyo Willow Riparian Forest
RS	Riparian Scrub
OW	Live Oak Woodland

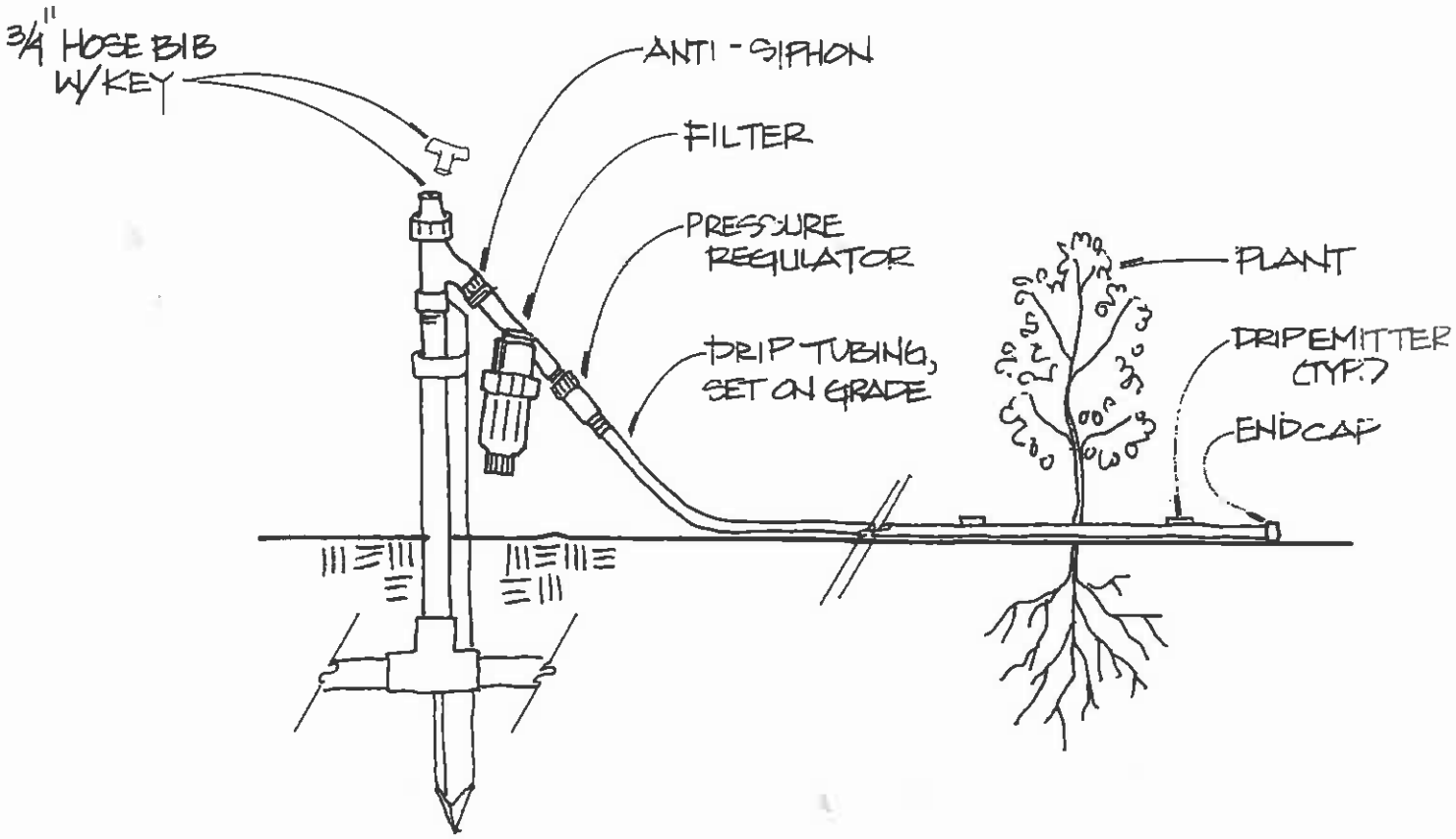
Scale 1" = 1000'

0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

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Jones & Stokes Associates, Inc.

Figure H-4
Typical Drip Irrigation Assembly with Hose Bib Point of Connection

The objective of restoring native habitats is related to another National Park Service objective: to create and enhance habitat for rare plants. Rare plant enhancement recommendations are provided in Appendix I.

Appendix H is divided into three sections. The first section describes general restoration concepts and methods to be applied to all restoration sites. The second section describes restoration methods for each plant community type. The third section describes the existing conditions and restoration recommendations at proposed forest removal sites.

GENERAL RESTORATION CONCEPTS AND METHODS

The general restoration concepts and methods described below are guiding recommendations for all proposed forest removal where native plant community restoration will take place. Some of these recommendations are applicable to only some of the restored habitat types. This section discusses general recommendations for the following:

- using locally native plant material for restoration and collecting, storing, stratifying, and germinating seed;
- protecting and restoring soil conditions,
- irrigating plantings; and
- controlling aggressive weeds.

Plant Material

All plant material (i.e., seeds, cuttings, and whole plants) used for habitat restoration projects on the Presidio should be derived from populations of locally native species presently occurring at the Presidio. Restricting plant material to only locally derived sources (within the Presidio) will serve to protect locally distinct genetic types. Plant material will be propagated for the restoration program in the native plant nursery, described in the following section. This guidance does not apply to restoration of the historic forest, but only to restoration of native plant communities.

The location of the Presidio at the tip of the San Francisco Peninsula results in the isolation of Presidio native plant populations from other populations of the same species. The occurrence of uncommon serpentine soils in an unusual coastal setting at the Presidio results in unique habitat

conditions that produce new plant species and subspecies. Because of the geographic isolation and unique environmental conditions of the Presidio, many of the plant species likely support locally adapted or unusual neutral genetic differences in their Presidio populations compared with other populations of the same species found elsewhere. The presence of so many rare plant species at the Presidio lends support to the assumption that the genetic make-up of populations of common native plants here may be unusual or unique. Funding and time are not available to study the genetic make-up, morphological variation, and ecological adaptations of populations of each native plant species that occur at the Presidio; therefore, based on ecological and genetic theory, it would be prudent to avoid introducing new genetic material of native plants from populations outside the Presidio. Such a practice would help preserve the uniqueness of the native plant species at the Presidio.

Native Plant Salvage Prior to Removal of Trees

Wherever possible, native plants should be salvaged (seed, cuttings, or whole plants) prior to forest removal or other vegetation-disturbing actions at the Presidio. This salvaged material can be used in habitat restoration efforts. Salvaged plant material can be directly replanted into previously prepared habitat restoration sites or stored or propagated at the native plant nursery described below.

Native Plant Nursery

A native plant nursery should be established at the Presidio. This nursery will be used to store and propagate native plant material for use in habitat restoration projects. The nursery should include facilities for:

- storing seeds and cuttings;
- growing and propagating whole plants (established from seed, cuttings, or direct collection from the field); and
- conducting experiments to determine the best storage, growth, and propagation methods.

Contract growing with commercial nurseries could also be conducted. Offsite growing, however, increases the risk of contamination of stock with nonlocal genes.

Seed Collection

A major limiting factor in native plant restoration in removed forest sites is native seed availability. Populations of native species used in habitat restoration must be identified that are large enough to be suitable for collecting seed. The appropriate timing for collecting seed of each species must be determined. To facilitate locating herbaceous plants during fruiting, the locations of individuals or populations can be marked in the spring, when floral displays make them most visible, with bright-colored survey ribbon, pin flags, or with painted wooden stakes. Care must be taken to avoid overharvesting of seed. Detailed records of the amount, location, and timing of seed collected should be maintained for each species. It may be necessary to tie cheesecloth or paper bags over fruiting stems before they are completely ripe to protect them from predation by animals. To maximize genetic diversity in seed stocks, seed should be collected from many individuals within populations and from separate populations. Selective seed collection can be done by hand stripping. Seed can be collected from native grasslands by mowing with a collection bag. Small seed from sites relatively free of non-natives can be vacuumed from the area directly around the plants after seeds fall. Populations of wind-dispersed species may need to be protected with screen canopies to capture seeds blown from plants.

Seed Storage

To avoid mildew, collected seed should be completely dry before being stored. Large amounts of seed can be dried on plastic tarps indoors or outdoors in the sun if protected from wildlife and wind. Leaves, stems, fruit material, and other waste should be removed before storing seeds. Dry, clean seed should be bagged or placed in glass jars and labeled, until ready for sowing. A pinch of dry captan with each bag of seed will discourage insects and fungus from destroying the seed during storage. (Schmidt 1980.)

Stratification

Several of the dominant shrub species will need some sort of cold stratification to break dormancy and begin germination. Approximate stratification times, if required, are given for each dominant species discussed below. Stratification trials, however, should be conducted in the nursery for each species, testing a range of refrigeration periods: 30-, 60-, and 90-day periods. For stratification of most species, the seed should be mixed with moist sand, peat, or sphagnum moss; placed in plastic bags; dated; and refrigerated for the suggested length of time. Seed swelling should be checked to determine readiness for planting.

Germination and Planting

Fresh and treated seed can be germinated in flats or liners. Once seedlings are established and before they become container bound, they should be carefully transferred to a larger container. Nursery-grown material should generally be planted out when the plant has an established root system that firmly holds soil without being root bound. The length of time for each species to reach this stage varies greatly. A horticulturalist specializing in native plant propagation should be consulted for more information.

Care and Storage of Cutting Material

Dominant plant species that can be propagated by cuttings and the recommended time of year for collecting these plants are noted in the "Seed Collection and Propagation Techniques" section for each habitat type. Cuttings should be taken from non-flowering, vigorous branch tips. The cuttings should be approximately 3 inches long. It is important that the cuttings not be allowed to dry out. A rooting hormone can be used to facilitate rooting. A rooting medium of clean, coarse perlite and vermiculite is commonly used. The length of time required for rooting will vary from species to species. A horticulturalist specializing in native plant propagation should be consulted for more information.

Soil Conditions

Establishing appropriate soil conditions at restoration sites is key to the success of native habitat restoration. Close attention to soil preparation at restoration sites will result in the need for fewer remedial actions, lower maintenance costs, and greater probability for habitat restoration success. The sections below describe several important measures to enhance soil conditions when preparing forest removal sites for restoration.

Soil Compaction

Heavy equipment used for forest removal could result in soil compaction, especially on non-dune soils: Cronkhite, Barnabe, Kron, Henneke, Pablo, and Bayview. Soil compaction can reduce site quality for restoration of coastal prairie, coastal scrub, serpentine grassland, serpentine chaparral, and oak woodland habitats. Soil compaction should be avoided at restoration sites. Heavy equipment should be kept off sensitive restoration sites to the greatest extent possible. Measures that can be used to reduce soil compaction include:

- using equipment with rubber tires;

- using hand-held chain saws to fell trees, remove limbs, and section logs to a manageable size for removal from the site;
- rolling logs downhill to the removal site if suitable slopes are present;
- dragging logs from the site with cables from an offsite winch, but logs should be small enough to avoid seriously gouging the soil; and
- using a limited number of skid trails to localize soil compaction and rehabilitating soils on the skid trail following removal of material.

Slash, Debris, and Stump Removal

All slash and debris should be removed after forest-cutting operations end. Stumps can be removed or left in the ground on dune soils. Stumps on dune soils may be pulled or ground and chipped in place. If stumps are removed, dune contours should be restored following removal. If stumps are to remain, they should be cut to ground level. To minimize soil disturbance on non-dune soils, stumps should be left in the ground and cut to ground level. Stumps on non-dune soils may be ground and chipped in place if this task can be accomplished without soil disturbance or compaction from equipment. No pulling of stumps should be conducted on non-dune soils.

Accumulated Litter and Duff Removal

Litter and duff have accumulated under the forests, especially under Monterey pine and eucalyptus. Litter is undecayed plant material such as leaves, needles, and twigs. Duff is the partially decomposed organic material derived from the litter layer. Deep duff layers are not typical of native non-forest habitats of the Presidio and may retard the establishment of native plants. The decomposed duff layer increases the water-holding capacity and fertility of dune sands and serpentine-derived soils. The increased water-holding capacity and fertility of the soil favors non-native weedy species over native species adapted to well-drained, low-fertility native soils. The litter layer may reduce nitrogen availability or, in the case of eucalyptus, introduce allelopathic compounds into the soil. A thick litter and duff layer can also preclude seed germination or seedling establishment by physically preventing contact with the mineral soil beneath.

Litter and duff should be removed where possible. At some sites, the duff layer is more than 1 foot thick. Duff should be removed carefully so that disturbance of the underlying soil is minimized. This is particularly important for serpentine soils. Litter and duff can be removed using hand tools or mechanical methods. A variety of methods should be tested and the least damaging, most efficient method chosen. Sites supporting dune sands may be disturbed during

litter and duff removal without jeopardizing the ability of the site to support native dune scrub species. Dunes should be recontoured following duff removal.

Burning of litter and duff may be conducted where feasible; however, safety and air quality considerations must be addressed. On serpentine soils, burning may be the best way to remove the duff without disturbing the underlying soil. The heat of the fire may also have beneficial effects on seed germination of some native species. Burning litter and duff derived from eucalyptus may exacerbate hydrophobic soil conditions (see discussion below) and is not recommended.

Hydrophobic Soils

Hydrophobic (water-repelling) organic compounds such as phenolics and terpenes derived from plants can create a water-repelling layer in the soil. Hydrophobic soils tend to shed water, resulting in surface sheet flow and increased erosion potential. At the Presidio, hydrophobic conditions occur in sandy Sirdrak soils under Monterey pine, eucalyptus, and to a lesser extent under Monterey cypress. Serpentine soils under eucalyptus may be weakly hydrophobic.

Control of hydrophobic conditions will be necessary on sandy sites where dune scrub restoration will occur. The hydrophobic character of the soil must be counteracted to reduce the amount of runoff that contributes to erosion and gully formation. Treatments to reduce hydrophobic conditions in soils are presented in Chapter 3. The recommended method for enhancing native vegetation restoration sites is the addition of lime to the soil to increase the pH. Acidic pH is a contributory factor to hydrophobicity. Increasing the pH to 6.0 should help reduce hydrophobicity. Lime should not be added to serpentine soils, as the natural imbalance of calcium and magnesium in these soils contributes to the unique nature of the vegetation they support.

For sites where hydrophobic conditions are not extremely advanced, given time, this problem should eventually resolve itself as hydrophobic compounds are decomposed within or leached from the soil.

Studies have indicated that a fire-induced hydrophobic soil condition or repellency is significantly reduced after only 1 year and is negligible after 5-10 years (Wallis and Horne 1992). No comparable research results are available for hydrophobicity induced by incorporation of conifer and eucalyptus organic matter over many years. Indirect evidence of the longevity of the hydrophobic effect may be inferred from the observation of the temporary relief of hydrophobicity provided by chemical wetting agents (Wallis and Horne 1992). The decomposition and dispersal of the cultural forest-derived organic compounds contributing to the hydrophobic condition would likely occur only over a period of at least decades. Therefore, a natural decomposition process should not be relied on to reduce accelerated erosion resulting from hydrophobicity, and the recommended mitigation measures to counteract the hydrophobic condition should be applied.

Soil Acidity

Organic material, especially that derived from conifers such as Monterey pine, is generally acidic and the accumulation of organic material in the soil increases the soil acidity. The acidity of soils under the forests at the Presidio may be greater (lower pH) than the acidity of these soils prior to forest establishment. Acid soil conditions could retard the establishment of some native plant species. Dune soils are expected to fall within a pH range of 6.5 to 8.0 (Barbour and Johnson 1988). Kruckeberg (1984) identified a range of pH levels for serpentine soils throughout California between 5.6 and 8.8 with the mean and most individual samples near neutral pH.

At most sites, once the forest and duff are removed, the acid soil problem should eventually resolve itself as soil conditions slowly tend toward neutral. If severely acid soils are present, these sites could be treated with lime after duff removal, but before replanting. As a general rule, soils with pH <6.0 should be treated with lime to stabilize the pH between 6.0 and 7.5. Serpentine soils should not be treated with lime.

Erosion Control

For habitat restoration to succeed, soil erosion following removal of forest stands should be controlled. Detailed soil erosion control methods are described in the soils and geology section in Chapter 3. One or more of the following erosion control methods should be incorporated at habitat restoration sites:

- avoid tree and log removal in winter and spring when soils are moist and most vulnerable to compaction, rutting, and erosion;
- redirect foot traffic and restructure trails;
- redirect drainage and construct drainage facilities;
- repair gullies;
- reduce runoff by counteracting hydrophobic conditions;
- control sediment runoff with temporary siltation fences or catch basins;
- stabilize soil with suitable erosion-control blankets or netting and straw mulch (seedless or rice straw); and
- revegetate with native species immediately following tree removal.

The conventional method for controlling erosion on large areas of bare soil is grass seeding. This method is inappropriate for most of the restoration sites because a grass cover will

interfere with native habitat restoration. Seeding for erosion control could be conducted in coastal prairie, serpentine grassland, and oak woodland, if sufficient amounts of appropriate native grass seed can be obtained. Existing native grasslands can be mown while in seed, and the resulting bagged straw and seed mix can be spread over restoration sites as an erosion control mix.

On steep slopes, blankets or netting and straw can be used to stabilize the surface in the short term. Native plants installed within the blankets or netting should eventually stabilize these sites. Netting alone is not an effective erosion control tool on steep or sandy slopes.

Straw should be crimped immediately into recontoured dunes on dune scrub restoration sites. Native plants also should be installed immediately after exotic tree and duff removal to begin dune stabilization.

Irrigation

Irrigation, especially spray irrigation, is not generally recommended for dune restoration because it can promote the growth of non-native grasses and forbs. Temporary drip irrigation systems could be used as a precautionary measure to protect plantings of perennials from failing during unusual drought periods in the first 3 years of restoration. Drip irrigation, especially if combined with weed mats, can enhance the success of plantings without promoting weeds.

Collecting, growing, and planting native plants to establish new populations is labor intensive and time consuming. To ensure that plant establishment does not fail because of unusually warm temperatures or low precipitation, temporary drip irrigation systems could be installed at each site where nursery-grown material is the dominant form of revegetation. Many sites are small enough to use drip lines tied into nearby hose bibs.

Figure H-4 depicts the generic assembly of a drip system suitable for small revegetation sites (i.e., 2 acres or less). Half-inch diameter polyethylene distribution tubing can be run to each plant with a 0.5- to 2-gallon-per-hour emitter attached directly to the line and placed at the base of the plant. The system can be operated as necessary to protect plants during prolonged hot, dry periods or after desiccating winds. Once the plants are established (one to two growing seasons), the system can be relocated to the next revegetation site and retrofitted to suit a new planting layout. An irrigation specialist or irrigation equipment distribution center can be contacted for more information on equipment and design.

Small planting sites without accessible piped water can be hand or truck watered if equipment access is provided.

Aggressive Weeds

Aggressive, non-native plants (weeds) have established over most of the Presidio. Several weed species are of particular concern because they rapidly overtake and out-compete native vegetation, especially on recently disturbed sites. These weed species must be controlled during the restoration process. Because of the large populations of weeds at sites surrounding restoration areas, long-term management of restored native vegetation will be necessary to control weeds. Weed patches near restoration sites should also be treated to suppress sources of propagules. Aggressive weed species found at restoration sites and needing strong control measures are:

- English ivy (*Hedera helix*),
- German ivy (*Senecio mikanioides*),
- African ice plant (*Carpobrotus edulis*),
- Scotch broom (*Cytisus scoparius*),
- French broom (*Genista monspessulana*),
- gorse (*Ulex eurpaea*),
- cotoneaster (*Cotoneaster* spp.),
- blue gum eucalyptus (*Eucalyptus globulus*), and
- everlasting pea (*Lathyrus latifolius*)

English Ivy and German Ivy

English ivy and German ivy can be removed by hand and by application of herbicides. Systemic herbicides should be applied to growing foliage with a hand sprayer, taking care to avoid native vegetation. Roundup or Redeem with a surfactant will kill ivy (Elliot 1994). Repeat spraying will be necessary to kill resprouting stems. Ivy growing on the trunks of oaks increases moisture levels of the bark and can hasten disease attacks on the trees. All ivy growing on the trunks of oaks should be cut from the base and as much pulled off the trunk as possible.

African Ice Plant

African ice plant can be removed by hand pulling, mechanical excavation, and application of herbicides. Roundup applied at 1.5-2% solution with 0.5% nonionic surfactant herbicide will kill ice plant in 6-8 weeks (Monsanto Company n.d.a) Herbicide should be applied in late fall after native species have reseeded and before winter rains. Dead plant material can be left in place to provide erosion control. Ice plant is a succulent that accumulates salt; consequently, dead material can increase soil salt content. However, native dune scrub species are expected to have some tolerance to salt.

French Broom, Scotch Broom, and Cotoneaster

Seedlings and small shrubs of brooms and cotoneaster can be removed by hand when the soil is moist or with a weed puller for large shrubs. Shrubs that are too large to pull should be cut at ground level. Archbald (1994) recommends cutting mature French broom in July or August when stored energy reserves are lowest in the root system. This likely applies to Scotch broom and cotoneaster as well. Freshly cut broom stems can be painted with concentrated Round-up or 2,4-D to suppress resprouts. Brooms leave a great deal of seed in the soil and restoration sites will require 5-10 years of broom seedling removal to prevent recolonization.

Eucalyptus

Eucalyptus trees may resprout from roots following removal of the bole. Freshly cut eucalyptus stumps should be painted with full strength Roundup or Rodeo immediately after cutting to kill the root system (Monsanto Company n.d.b). If eucalyptus resprout, the resprouts can be treated with 2% Roundup or 1.5% Rodeo solution plus 0.5% nonionic surfactant herbicide (Monsanto Company n.d.b) during the growing season when they reach 6-8 feet tall; however, the recommended method is to cut resprouts and immediately paint the cut face with full-strength herbicide.

Other Weeds

In addition to the above-mentioned weeds, many other weeds occur at the Presidio and may serve to retard the establishment of native vegetation. These weeds include:

- annual grasses such as ripgut brome (*Bromus diandrus*), wild oats (*Avena fatua*), slender oats (*Avena barbata*), rattlesnake grass (*Briza maxima*), soft chess (*Bromus mollis*), Mediterranean barley (*Hordeum geniculatum*), wild barley (*Hordeum murinum* var. *leporinum*), and Italian ryegrass (*Lolium multiflorum*);

- perennial grasses such as velvet grass (*Holcus lanatus*), pampas grass (*Cortaderia jubata*), and perennial ryegrass (*Lolium perenne*);

- annual forbs such as black mustard (*Brassica nigra*), wild radish (*Raphanis sativus*), and filaree (*Erodium* spp.);

- perennial forbs such as Australian fireweed (*Erectites glomerata*), narrow-leaf ice plant (*Conicosia pugioniformis*), Bermuda buttercup (*Oxalis pes-caprae*), nasturtium (*Topaeolum majus*), cheeseweed (*Malva nicaeensis*), and fennel (*Foeniculum vulgare*); and

- shrubs and vines such as Himalaya berry (*Rubus discolor*), maidenhair vine (*Muhlenbeckia complexa*), and gorse (*Ulex europaea*).

Control measures for these weeds may also be needed where they are outcompeting native species. In most cases, appropriate site preparation should minimize weed problems. Annual grasses and forbs are a naturalized component of all of the native plant communities of the Presidio and cannot be eradicated without extremely intensive and expensive measures. Efforts to control annual grasses and forbs should be conducted only if they interfere with the initial establishment of native plants. Irrigation and fertilizers favor these annual species and should be used only when necessary to ensure survival of native plants. Weed mats and spot herbicide spraying can be used to control annual grasses and forbs around native plantings early in the restoration process. At grassland restoration sites (coastal prairie and serpentine grassland), properly timed mowing can reduce the seed production of non-native annual grasses. Where non-native forbs preclude establishment of native grasslands, a broadleaf-specific herbicide could be used to control weeds. Where non-native annual grasses preclude establishment of dune scrub, a grass-specific herbicide could be used to control weeds.

RESTORATION METHODS BY HABITAT TYPE

Forest removal sites at the Presidio historically supported six different native habitats. Restoration methods for these six habitat types are described in this section. For dominant plant species in each habitat, recommendations are provided regarding:

- seed collection,
- propagation techniques,
- planting methods, and
- quantity of material to use.

Native plant species known to occur at the Presidio that can be used for restoration of native habitats are given in Table H-1. Dominant species are emphasized in the restoration methods described here, but other species from the list can be incorporated into planting efforts as whole plants, cuttings, or in seed mixes.

Dune Scrub

Dominant species that should be established in dune scrub restoration sites are coyote brush (*Baccharis pilularis*), mock heather (*Ericameria ericoides*), coast buckwheat (*Eriogonum latifolium*), golden yarrow (*Eriophyllum staechadilfolium* var. *artemisiaefolium*), bush lupine

Table H-2. Example of Composition of Seed Mix and Container Stock for Restoration of Dune Scrub Habitat

Plant Species	Percent of Seed Mix[a]	Percent of Container Stock
Coyote brush	10	20
Mock heather	20	20
Coast buckwheat	20	15
Golden yarrow	20	15
Bush lupine	15	15
Chamisso lupine	15	5
California blackberry	0	10
Total	100	100

[a] Percent of seed mix should be calculated by approximate number of seeds (not by weight), estimate based on an average number of seeds/pound.

(*Lupinus arboreous*), chamisso lupine (*Lupinus chamissonis*), and California blackberry (*Rubus ursinus*).

Seed Collection and Propagation Techniques

Coyote brush germinates from seed easily and also grows from cuttings taken at any time of the year (Chandler pers. comm.). Experiments with direct seeding of coyote brush could be conducted, and direct seeding could be used if proven effective.

Mock heather has a low germination rate, approximately 20%. This means a large quantity of seed is needed for successful establishment when direct seeding is performed. It is best to plant mock heather from container stock, grown from cuttings or seed in the nursery. Cuttings should be collected in October and November (Kephart pers. comm.).

Coast buckwheat can be propagated from seed. No treatment is necessary to germinate seed.

Golden yarrow is easily grown from seed. Experiments with direct seeding of golden yarrow could be conducted and direct seeding could be used if proven effective.

Bush lupine and chamisso lupine can be grown from seed without pretreating if the seed is fresh (Chandler pers. comm.). If the seed has been stored, it must be scarified before sowing.

California blackberry can be grown from cuttings at any time of the year.

Planting Methods and Quantities

Following removal of forest stands, weeds, and duff from dune scrub restoration sites, the sandy soils must be stabilized. The use of straw mulch is an effective and cost-efficient technique for erosion control. Handfuls of rice or wheat straw should be buried 3-4 inches into the sand, leaving 6-10 inches above the ground and vertically oriented. Straw bundles should be planted 1-2 feet apart. This method of plugging straw mulch into the sand will reduce wind velocities at the surface of the sand and reduce the amount of wind-borne sand. It also leaves large areas of sand uncovered, which will favor plant establishment. This technique requires 200 pounds of straw per acre (Ferreira 1987). On larger sites, a mechanical straw crimper-roller is more efficient than hand plugging.

A combination of direct seeding and planting of nursery stock should be used to revegetate dune scrub sites. Seeding and planting should take place in fall following the first rain that is sufficient to moisten the top 4-6 inches of soil. Revegetation should be completed by March to give plants time to establish before the summer drought. Seed should be broadcast by hand or with belly-grinders for more consistent application. On larger sites a mechanical seed drill or fan

spreader could be more efficient than hand methods. Nursery stock can be planted immediately following seeding. Soil disturbance associated with planting should be sufficient to work seed into the soil and improve germination (Moss 1993). If direct seeding is the only method selected for revegetating a site, the seed should be lightly raked 0.25-0.5 inch into the soil.

Seed should be applied in predetermined species ratios within the confines of the limited propagation sources found on the Presidio. Table H-2 lists recommended species and relative composition, as an example. The park natural resources staff will determine the exact ratios for each habitat type prior to planting. Nursery stock should be spaced approximately 4 feet on center (not in rows), resulting in approximately 2,722 plants per acre.

Supplemental irrigation using a simple drip system can improve survival rates of nursery stock during dry periods until plants become established. If the plants are carefully monitored, occasional hand watering (once every 2 weeks) may be sufficient to carry establishing plants through the first dry season.

Weed species should be controlled before planting begins. Where possible, weeds at the perimeter of the revegetation site should also be removed or controlled so that wind-borne seed, runners, and tillers do not create a weed nuisance on the site. The section "General Restoration Concepts and Methods" provides information on the control of major weed species.

Serpentine Grassland

The dominant species to be planted in serpentine grassland is California oat grass (*Danthonia californica*). Purple needlegrass (*Nassella pulchra*) and foothill needlegrass (*Nassella lepida*) are subdominant species.

At serpentine grassland restoration sites, extra care should be taken to avoid compaction of serpentine soils during tree and duff removal. The section "General Restoration Concepts and Methods" discusses methods to avoid soil compaction. If large areas become compacted, it may be necessary to lightly harrow soils before planting (Strahan and Wolley 1987).

Seed Collection and Propagation Techniques

Purple needlegrass and foothill needlegrass can be grown from seed in the nursery and outplanted from flats or plugs or direct seeded. A combination of outplanting and direct seeding techniques may be the most successful method. Seed can be collected by hand in late spring to early summer. In stands of serpentine grassland that are relatively weed free (i.e., more than 85% native cover), seed can be collected by mowing with a collection bag. For small, patchy stands, a weed whip with a collection bag can be used. Overharvesting of seed, to the extent that existing

populations could be substantially reduced, should be avoided. Seed should be stored in a cool, dry place. If not enough wild grass seed is available from the Presidio, it may be necessary to propagate seed in the nursery for several seasons until enough seed is available for revegetation. The seed supply can also be increased through a contract grower as long as care is taken not to contaminate Presidio genetic stock with non-local genotypes.

Forbs and other grasses should be introduced in small patches in appropriate soil niches by direct seeding or plug planting. Seed for these species can be collected by hand, mowing, or vacuuming areas where relatively pure stands of target species occur.

Planting Methods and Quantities

Seed should be applied at predetermined species ratios within the confines of the limited seed sources found on the Presidio and raked into the top 0.25-0.75 inch of soil before the first rains in fall. Plugs or liners can be planted out in late December or early January at a spacing of approximately 8 inches on center (not in rows).

Weeds should be controlled to the greatest extent possible prior to planting. Ideally, planting and seeding should take place immediately after site preparation to minimize weed establishment. Non-native, annual grasses can be controlled by mowing, light grazing, or burning before seed maturation. Although burning may not be feasible in an urban setting, where it can be used it provides the benefits of reducing mulch and the amount of weed seed stored in the soil (Amme n.d.). In cases where pure stands of non-native annual grasses have established on restoration sites, selective herbicides can be applied on successive germinations in the fall, or the first inch of soil can be scraped and buried or discarded.

After native grasses are planted, if non-native, annual grasses continue to be a problem, they can be controlled through properly timed mowing practices. Mowing in late spring reduces annual grass seed production and often encourages tillering of native perennial grasses (Pacific Coast Seed n.d.).

Serpentine Chaparral

The dominant shrub species to be planted in serpentine chaparral are Raven's manzanita (*Arctostaphylos hookeri* var. *ravenii*), toyon (*Heteromeles arbutifolia*), coyote brush, blue-blossom ceanothus (*Ceanothus thyrsiflorus*), and California coffeeberry (*Rhamnus californica*).

Seed Collection and Propagation Techniques

Raven's manzanita can be propagated and outplanted from cuttings. Appendix I contains more information on Raven's manzanita propagation techniques.

Toyon and coffeeberry can be grown from seed. Seed should be collected in late fall or early winter. Seed should be dried and cleaned before sowing.

The section "Dune Scrub" above contains a discussion of propagation methods for coyote brush.

Blue-blossom ceanothus can be propagated from cuttings collected in the fall or grown from seed. Both erect and prostrate (previously known as var. *repens*) forms occur at the Presidio and can be used for restoration. Seed should be collected in June, water treated and stratified for 3 months, and sown between January 1 and April 30 (Chandler pers. comm.).

Planting Methods and Quantities

Nursery stock of serpentine chaparral shrubs can be planted from November through January. Plants should be Dee-Pot size before planting out (a standard Dee-Pot is 2.5 inches in diameter by 10 inches long and about 40 cubic inches in volume). If smaller specimens are planted, the planting densities should be increased accordingly.

Shrubs should be planted at a density of 608 per acre. Plantings should be grouped into clusters of six to 24 plants, spaced 4-5 feet on center (not in rows). Toyon, coffeeberry, ceanothus, and coyote brush should be mixed in varying proportions in each planting cluster. Raven's manzanita should be planted in pure stands with abundant open space surrounding the cluster for future growth. The prostrate variety of ceanothus should be planted at sites exposed to coastal winds and the erect variety at more sheltered sites. An example of proportions of dominant shrubs planted at each restoration site is provided in Table H-3.

The simple drip irrigation assembly described in the "General Information" section may be useful to encourage establishment of plants. It can be used during the first two growing seasons or until plants are adequately established to survive on their own.

An area of at least 30 inches radius around each plant should be maintained free of weeds until plants are sufficiently established to compete successfully with weeds. Weeds can be controlled using selective herbicides or hand removal.

Table H-3. Example of Planting Composition of Container Stock for Restoration of Serpentine Chaparral Habitat

Plant Species	Percent of Container Stock
Raven's manzanita	10
Coyote brush	10
Coffeeberry	20
Blue-blossom ceanothus (prostrate and erect varieties)	30
Toyon	30
Total	100

Coastal Prairie

Dominant grasses that should be used for coastal prairie restoration are California oatgrass (*Danthonia californica*), purple needlegrass, foothill needlegrass, California brome (*Bromus carinatus*), blue wildrye (*Elymus glaucus*), red fescue (*Festuca rubra*), creeping wildrye (*Leymus triticoides*), and California melic grass (*Melica californica*).

Seed Collection and Propagation Techniques

Seed of native grass species can be collected from midspring to midsummer depending on the species and the location of collection. Generally, native grass seed will ripen in April and May. Grass seed is easily collected by hand. Seeds from native forbs of the coastal prairie may require other techniques (e.g., mowing or vacuuming as described in the methods for serpentine grassland).

California brome, blue wildrye, red fescue, purple needlegrass, and foothill needlegrass can be successfully grown by direct broadcast seeding and raking or ring rolling seed into the top 0.25-0.5 inch of the soil. It is important that seed have firm contact with the soil for successful germination (Amme n.d.).

Creeping wildrye, California melic grass, and California oatgrass are difficult to establish by direct seeding and should be nursery grown and plug planted in stands to establish populations at restoration sites. California oatgrass has a less than 5% germination rate without treatment. Germination of this species is most successful by hand removing the hulls, placing the seed on germination towels presoaked with gibberellic acid at 400 parts per million, towels are rolled-up and stratified for 2 weeks in the refrigerator (Knapp pers. comm.). This method can increase the germination rate of California oatgrass to 90%. This process is to be used only for greenhouse germination, and seed treated in this manner should not be sown in the field.

Planting Methods and Quantities

Native grasses should be seeded at 30-50 pounds per acre depending on the availability of seed. The lower seeding rate is recommended when combining seeding with plug planting. An example of seeding rates at coastal prairie restoration sites is given in Table H-4.

Seed should be broadcast between mid-November and January 1. Plugs or liners can be planted out from November through February.

Management programs to control weed seed populations in the soil, as described in the "Serpentine Grassland" section, will greatly aid the establishment of native grasses. Another method that can be used to control weed seed populations is to irrigate (or wait for the first rains)

Table H-4. Example of Seed Amounts for Coastal Prairie Restoration

Plant Species	Amount of Seed (Pounds/Acre)
Red brome	8
Blue wildrye	8
Red fescue	4
Purple needlegrass	10
Foothill needlegrass	10
Creeping wildrye	4
California melic grass	3
California oatgrass	3
Total	50

following tree removal to germinate weed seeds and control the resulting weeds with contact herbicides, harrowing, or disking before planting native grasses and forbs. If annual weeds are a severe problem, a second crop of weeds should be allowed to germinate and be controlled.

Coastal Scrub

Dominant and associated shrub species that should be established at coastal scrub restoration sites are bush monkeyflower (*Mimulus aurantiacus*), California blackberry, coyote brush, blue-blossom ceanothus, coast buckwheat, golden yarrow, California coffeeberry (*Rhamnus californica*), and California wax-myrtle. Coastal prairie grasses and forbs should be planted as an understory to the coastal scrub shrubs.

Seed Collection and Propagation Techniques

The section "Serpentine Chaparral" discusses seed collection and propagation techniques for coyote brush and blue-blossom ceanothus. The section "Dune Scrub" discusses seed collection and propagation techniques for California blackberry, golden yarrow, and coast buckwheat.

Bush monkeyflower can be grown from seed without treatment. California wax-myrtle can be grown from cuttings taken in fall or nursery grown from seed collected in spring and stratified for 3 months. California coffeeberry can be grown from cuttings taken in the fall or grown from seed. Coffeeberry seed can be collected in late summer and should be stratified for 1-3 months.

Planting Methods and Quantities

Plantings of dominant shrubs for coastal scrub restoration are most successful when established from container plants. Shrubs should be planted in groups of 10-25 individuals spaced 5-8 feet on center (not in rows). Coastal prairie grasses and forbs should be seeded as an understory (see the section "Coastal Prairie" for more information). Openings of 200-300 square feet should be left between planted areas. Plugs of coastal prairie grasses should be planted in groups of 40 individuals, spaced 8 inches on center (not in rows), in intervening spaces among shrub planting clusters. Seed of grasses and forbs native to coastal scrub should be distributed in these openings between the planted areas (see Table H-1 for appropriate species). Spreading native seed will encourage the establishment of natives and suppress the invasion of weedy species. The section "Dune Scrub" discusses recommendations on seeding techniques.

Coastal scrub restoration sites should have an average of 735 shrub plantings per acre and 600 grass plugs per acre. An example of proportions of shrubs species installed at each restoration site is given in Table H-5.

If possible, create a 48-inch diameter watering basin around each shrub and maintain free of weeds for the first 3 years after planting. Shrubs can be watered as needed using a drip line or by hand watering (see irrigation recommendations in the foregoing section of this appendix, "General Restoration Concepts and Methods").

Coast Live Oak Woodland

Coast live oak is the dominant canopy species that should be planted at oak woodland restoration sites. California buckeye should be established as an associated tree species. Dominant understory shrubs that should be established are toyon, coyote brush, bush monkeyflower, blue-blossom ceanothus (erect variety), California coffeeberry, and California blackberry.

Seed Collection and Propagation Techniques

Seed collection and propagation techniques for blue-blossom ceanothus, coyote brush, and toyon are described in the section "Serpentine Chaparral". Seed collection and propagation techniques for California blackberry are described in the section "Dune Scrub". Seed collection and propagation techniques for bush monkeyflower and California coffeeberry are described in the section "Coastal Scrub".

Coast live oak acorns can be collected in fall. It is best to harvest acorns directly from the tree because acorns on the ground are often not viable. Viability can be verified by floating acorns in water: Those that float are usually not good. Select acorns without insect holes. Acorns should be dry and stratified in a refrigerator for 1-2 months and are ready for planting when the radical (embryonic root) begins to grow.

Planting Methods and Quantities

The non-native trees existing on the sites to be replanted with oak woodland provide valuable wildlife habitat. To maintain a balance between the two goals of maintaining existing wildlife habitat value and restoring native oak woodland, exotic tree removal and oak planting should be phased. Forest replacement could be achieved by cutting existing forest and installing oaks in phases separated by 10-year intervals for each stand. To facilitate access and avoid

Table H-5. Example of Composition of Container Stock for Restoration of Coastal Scrub Habitat

Plant Species	Percent of Container Stock
Coyote brush	20
Blue-blossom ceanothus (prostrate and erect varieties)	20
Bush monkeyflower	20
California blackberry	20
Other species (Coast buckwheat, Golden yarrow, California wax-myrtle, and California coffeeberry)	20
Total	100

disturbance of newly established oaks, forest stands would be removed in portions, each connected to access roads.

Where oak woodland restoration sites are adjacent to eucalyptus stands, annual removal of eucalyptus leaf litter that falls in the restoration site will be necessary during the oak woodland establishment period because of the allelopathic effects of eucalyptus resins.

Coast live oak is most successfully established when planted as acorns or rooted acorns. Coast live oak should be planted at 15-20 feet on center spacing throughout the site. An average of 150 oaks should be planted per acre. California buckeye can be established from rooted seeds. About 10 buckeyes should be planted per acre randomly mixed with the oak plantings.

Oak woodland understory shrubs are most successful when established from container plants. Shrubs should be planted in groups of 10-15 individuals spaced 8 feet on center (not in rows). Gaps of approximately 400 square feet should be left between shrub groups. An average of 420 shrubs should be planted per acre. An example of proportions of dominant shrubs planted at each restoration site is provided in Table H-6.

Native grasses and other forbs should be seeded between the planted areas (see Table H-1 for appropriate species for oak woodland). Seeding of native species will encourage the establishment of natives and suppress the invasion of weedy species. The section "Dune Scrub" discusses recommendations on seeding techniques.

If possible, a 48 inch diameter watering basin should be created around each shrub and maintained free of weeds. Shrubs can be watered as needed using a drip line or hand watering (see irrigation recommendations in the section "General Restoration Concepts and Methods").

EXISTING CONDITIONS AND RESTORATION RECOMMENDATIONS BY SITE

This section provides descriptions of existing site conditions and restoration recommendations for most of the proposed forest removal sites at the Presidio. Sites are listed by stand numbers keyed to Figure H-1. Some stands are discussed together because they are in close geographic proximity, support similar soil and vegetation conditions, and will be restored to the same native habitat. For each site, the following information is provided:

- existing dominant vegetation,
- general soil and topographic information,
- problem weeds present,

Table H-6. Example of Planting Composition of Container Stock for Restoration of Oak Woodland Understory Habitat

Plant Species	Percent of Container Stock
Toyon	15
Coyote brush	15
Bush monkeyflower	15
Blue-blossom ceanothus (erect variety)	10
California blackberry	10
California coffeeberry	10
Other shrub species	25
Total	100

- native plants present that could be salvaged,
- native plant community recommended to be restored, and
- recommended restoration methods specific to the site.

Stand C263

This small site, with its steep slopes, supports Monterey cypress in front of Battery Boutelle at the top of the coastal bluffs. Cypress saplings occur along with German ivy, wild radish, wild oats, wild barley, and ripgut brome. Surrounding habitats are annual grassland to the north and south and serpentine chaparral to the west. This chaparral supports blue-blossom ceanothus, coyote brush, golden yarrow, and dudleya. This site should be restored to serpentine chaparral. Duff should be removed to expose serpentine substrate and weeds controlled. Raven's manzanita could be established here.

Northern Portion of Stand A273

This site supports shrubby black acacias and small Monterey cypress trees in front of Battery Godfrey. The site is open and weedy with fennel, myoporum, echium, black mustard, wild radish, English ivy, German ivy, Australian fireweed, nightshade, and annual grass. Native plants present that could be salvaged are golden yarrow and California blackberry. Soils may include fill material from construction of the battery. All vegetation should be cleared to the ground. This site should be restored to coastal scrub.

Stand P88

Northern Portion

This site supports a stand of Monterey pine with an understory dominated by poison-oak and Australian fireweed between Lincoln and Washington Boulevards. Scattered cotoneaster occur. The duff layer is thick. Native plants present that could be salvaged are blue-blossom ceanothus, Douglas' iris, California blackberry, and polypody fern. Duff and woody debris should be carefully removed without disturbing serpentine soils present. Part of the site appears to be on fill material. This fill material should be removed to expose serpentine substrate. The site should be restored to serpentine chaparral and barren. Extreme care should be taken during tree removal to avoid adversely affecting existing serpentine chaparral and rare plant populations to the north. This is an excellent site for expanding the existing populations of Raven's

manzanita, Presidio clarkia, and Marin dwarf flax that occur on the adjacent patch of serpentine chaparral and barren. Australian fireweed, cotoneaster, and pine seedlings should be controlled.

Southern Portion

This site supports a stand of Monterey pine with an understory dominated by poison-oak and Australian fireweed on dune soils between Lincoln and Washington Boulevards. Scattered cotoneaster occur. The duff layer is thick. Native plants that could be salvaged are blue-blossom ceanothus, Douglas' iris, California blackberry, and polypody fern. A healthy stand of native dune scrub habitat occurs to the south of this site and is dominated by coyote brush, mock heather, golden yarrow, California blackberry, bush lupine, and poison-oak. This site is in the transition zone between dune scrub and serpentine chaparral where dune sands likely overlay serpentine substrate. The site should be restored to dune scrub. Care should be taken during tree removal to avoid adversely affecting existing native dune scrub to the south. Duff and woody debris should be removed. The soil pH should be tested and, if necessary, corrected with lime to reduce acidity and hydrophobicity. Australian fireweed, cotoneaster, and pine seedlings should be controlled.

Stands P120 (Eastern Half) and E121 (Northern Portion)

These sites support mostly Monterey pine with eucalyptus on dune sands at the top of the west-facing slope below Washington Boulevard. The slopes here are steep. The understory is open and grassy with low shrubs. The duff layer is thick. Native plants that could be salvaged are California blackberry, bracken fern, mock heather, coyote brush, and California poppy. These sites should be restored to dune scrub. The duff should be removed and the dune recontoured. A pH adjustment should be made, if necessary. Jute netting and straw should be applied for soil stabilization.

Stands CP522 and C379 and Portions of Stands C47, PC46, and CP86

These five sites support cypress and pine on serpentine and sandstone soils and fill material next to Lincoln Boulevard near the World War II Memorial. German ivy and English ivy are serious problems in the understory. Native plants that could be salvaged are California blackberry, polypody fern, toyon, golden yarrow, and sword fern. The duff layer is thick. Serpentine chaparral should be restored on serpentine soils and coastal scrub on sandstone soils and fill material. The duff layer should be removed. Soil stabilization measures should be conducted on steeper slopes. Weeds should be controlled. Extreme care should be taken during

tree removal to avoid adversely affecting existing serpentine chaparral and rare plant populations. These are excellent sites for expanding the existing populations of Raven's manzanita, Presidio clarkia, and Marin dwarf flax that occur on the adjacent patch of serpentine chaparral and barren.

Stands C526, P541, and C542

These three sites support Monterey pine and cypress surrounded by paved storage areas and ice plant mats east of Battery Caulfield Road. The duff layer is thick. Ice plant is a major weed problem here. The sites should be restored to dune scrub habitat. Duff and woody debris should be removed. The soil pH should be corrected under pine and cypress. Ice plant should be controlled. Surrounding areas of dense ice plant mats will make control of ice plant difficult on these small sites. To make these three sites viable as dune scrub habitat, ice plant should be removed from all surrounding sites and those sites should also be restored to dune scrub.

Stands CP174 (Northern Portion) and C529

These sites support cypress and pine on either side of Battery Caulfield Road. The trees are in declining health, with many saplings in understory. In stand CP174, the understory is dense with Himalaya berry, wild radish, ice plant, poison hemlock, wild oats, poison-oak, German ivy, bush lupine, California bee plant, and smartweed. Salvage native bush lupine and California bee plant. The site is in a depression and soils are a more developed type for dune sands, with higher organic content and moisture. Many mesic plants occur here. Additional moisture may be the result of irrigation of lawns upslope. This site should be restored to dune scrub. Low areas may support freshwater seep if hydrologic conditions persist. Duff should be removed and dune sands recontoured. Coast live oak may survive here. The possibility of planting oaks with dune scrub vegetation should be considered. Himalaya berry, German ivy, and ice plant must be controlled.

Stand P177

This site, north of the Public Health Services Hospital, supports even-aged Monterey pine with an open understory and thick duff layer. Sparse cover in the understory includes poison-oak, ice plant, coast buckwheat, California strawberry, and chamisso lupine. The native buckwheat, strawberry, and lupine should be salvaged. Duff should be removed and soil pH corrected. This site should be restored to dune scrub, although portions of the stand may need to be retained as screening for the Public Health Service Hospital.

Stand A495

This site supports acacias to the east of the Public Health Services Hospital. It could be restored to dune scrub when landscaping is no longer needed.

Stands E234 and CP233

These two small stands adjacent to Mountain Lake support eucalyptus, cypress, and pine. Arroyo willow riparian forest occurs on the banks of the lake to the north and south of both stands. All non-native trees should be removed from these stands, and the site should be restored to coast live oak riparian forest and arroyo willow riparian forest at sites having the appropriate moisture regime and elevations.

Stands E53 (Corridor), E54, and E55 (Northern Portion)

Three sites, near the intersection of Schofield Road and Highway 1, support eucalyptus in an area that historically supported riparian forest. These sites are in an area where historical riparian hydrology has been modified. For these reasons, establishment and management of native habitat may be difficult. If soil moisture is not sufficient to support arroyo willow, coast live oaks should be planted as replacement trees.

Stands P135 and P138 (Southern Portions)

These sites support even-aged Monterey pine on serpentine soils near Inspiration Point. The understory is tall grasses, including velvet grass, and scattered shrubs of toyon, California blackberry, poison-oak, cotoneaster, and California coffeeberry. The duff is about 3 inches thick here, much thinner than where pine occurs on dune soils. The sites should be restored to serpentine grassland and barren. Duff should be carefully removed to retain top soil. If feasible, duff should be burned from soil surface. Native shrubs should be salvaged for oak woodland restoration sites. These sites presently receive heavy use from foot-traffic of people and dogs. Access should be restricted. Cotoneaster should be controlled. Duff removal and exposure to full sun likely will favor native serpentine grassland species. Serpentine barren habitat created can be seeded with Presidio clarkia and Marin dwarf flax.

Stands P135 and P138 (Northern Portions)

These sites, on Quarry Road, support open stands of Monterey pine on historically oak woodland sites. The understory is a complex mix of California blackberry, poison-oak, toyon, cotoneaster, French broom, Scotch broom, velvet grass, and German ivy. Duff layer is thick but should not cause problems to oak woodland. The sites should be restored to coast live oak woodland. Patches of existing native understory shrubs should be retained where it is possible to avoid them during forest removal. Toyon and blackberry should be salvaged. Cotoneaster, brooms, and German ivy must be controlled.

Stand E142 (Northeastern Portion)

This site, near Inspiration Point, supports large blue gum eucalyptus trees with a dense understory of English ivy on serpentine soils. Scattered coyote brush, poison-oak, poison hemlock, and nightshade occur. All duff and English ivy should be removed. Coyote brush should be salvaged for oak woodland restorations. Freshly cut eucalyptus stumps should be painted with systemic herbicide to prevent resprouting. This site should be restored to serpentine grassland. Serpentine barren habitat created can be seeded with Presidio clarkia and Marin dwarf flax.

Stand P135 (Separate South Stand)

This site, near Inspiration Point, supports an open stand of Monterey pine with intact serpentine grassland underneath. Pines should be cut and removed in pieces to minimize disturbance of serpentine grassland understory. Duff should be raked and removed from under trees. No additional treatment should be needed.

Stand A141 and Northern Portion of Stand C139

This site, near Inspiration Point, supports a stand of dense acacia and other shrub species and a stand of Monterey cypress on serpentine soils. All vegetation and duff should be cleared. The site can be restored to serpentine grassland and barren. Serpentine barren habitat created can be seeded with Presidio clarkia and Marin dwarf flax.

Stands C139 (Southern Portion) and C140

These two sites support Monterey cypress and Canary Island pine near Inspiration Point. These sites have sandy soils overlaying serpentine bedrock and were likely an ecotone between dune scrub, coastal scrub, and serpentine grassland. The sites can be restored to coastal scrub or a mix of dune scrub and coastal scrub species. French broom and cotoneaster must be controlled.

Stand R133

This site supports small coast redwood and Douglas-fir trees on serpentine soils northwest of Inspiration Point. The site is surrounded by serpentine grassland. Trees should be removed with minimum ground disturbance. Duff should be removed by burning, if feasible. This site can be restored to serpentine grassland. Freshly cut redwood stumps should be painted with systemic herbicide to prevent resprouting.

Stands Av132 and CT584

This site, on Arguello Boulevard, supports a stand of dense shrubby star acacia on shallow slopes and a stand of small cypress and large toyon on the road embankment. California blackberry occurs in the understory. All vegetation of the acacia stand should be cleared, and the site restored to serpentine prairie. Cypress and other non-native plants should be selectively removed from the cypress-toyon stand, avoiding damage to the large toyon present.

Stands E142 and C143

Except for existing eucalyptus and cypress south and east of Quarry Road, stands should be removed and replaced with coast live oak woodland in phases. Performance should be carefully monitored because coast live oak was probably not the original community on this site.

Stands C65 (Two Parts of Southern Portion), A101 (Eastern Half), P102, and A104

These sites support Monterey cypress with open understory; Monterey pine on steep slopes; and acacia between Washington Boulevard, Arguello Boulevard, and Infantry Terrace. Problem weeds are German ivy, English ivy, and Himalaya berry. A stand of non-native "coastal scrub" dominated by Himalaya berry and German ivy occurs between stands C65 and A101 and occurs in a mix with annual grassland between stands A101 and P102. Other weedy species in this habitat are mimosa, nightshade, and ice plant. All sites should be restored to coastal scrub. Weeds must be controlled. Jute netting and straw should be applied as soil stabilization measures before replanting.

Stands E109 (Northern Portion) and C108 (Eastern Half)

These sites support stands of blue gum eucalyptus and Monterey cypress with a shrubby understory between Hicks Road and Arguello Boulevard. Natives in the understory that can be salvaged are toyon, California blackberry, California bee plant, and honeysuckle. Poison-oak is also common. Non-natives in the understory that pose a weed problem are French broom, Scotch broom, English ivy, cotoneaster, and acacia. The sites should be restored to coast live oak woodland. To avert a temporal loss of the wildlife habitat value of the forest, the eucalyptus and cypress could be removed slowly and replaced with native oak. Patches of existing native understory shrubs should be retained where it is possible to avoid them during forest removal. Freshly cut eucalyptus stumps should be painted with systemic herbicide to prevent resprouting. All weeds must be controlled.

Stands E109 (Eastern Portion) and E110

This site, on Quarry Road, supports large eucalyptus trees with an understory dominated by English ivy. Also present in the understory are toyon, acacia, California blackberry, French broom, and Scotch broom. These sites should be restored to coast live oak woodland. Freshly cut eucalyptus stumps should be painted with systemic herbicide to prevent resprouting. Toyon should be salvaged or retained where possible. English ivy and brooms should be controlled.

Stand E137

This site supports eucalyptus on a northeast-facing slope that historically supported serpentine grassland, below Inspiration Point. The understory is a mix of black acacia, French broom, Scotch broom, California blackberry, toyon, Italian thistle, and wild oats. The site should be restored to serpentine grassland and barren. The north end of this site is nonserpentine soil and should be restored to coast live oak woodland. Freshly cut eucalyptus stumps should be painted with systemic herbicide to prevent resprouting. All weeds must be controlled.

Stand CP144

This site, near El Polin Spring, supports Monterey cypress and Monterey pine in an area that historically supported a mix of coast live oak woodland and riparian forest and coastal scrub. Restoration methods for coast live oak woodland should be effective on this site.

Stands E477 (Northern Half), E508, and A507 (Western Half)

These sites, near Julius Kahn Public Playground, support eucalyptus and acacia in areas that historically supported dune scrub. A remnant patch of dune scrub occurs immediately west of these sites. These three sites should be restored to dune scrub. Freshly cut eucalyptus stumps should be painted with systemic herbicide to prevent resprouting.

Stands C500, C236, C237, C515, C238, and C239 (Northern Portion)

These six small sites near Fort Point support Monterey cypress. All sites are surrounded by coastal scrub and bluff scrub. When any of these sites are no longer needed for landscaping, they could be restored to coastal scrub (C500, C236, C237) and bluff scrub (C515, C238, C239) habitats.

Stand E240 (Western Portion)

This site, below Battery East, supports blue gum eucalyptus with scattered Monterey cypress and an open weedy understory on a north-facing coastal slope. Understory species are German ivy, English ivy, myoporum, English holly, pittosporum, nasturtium, wild radish, and

cultivated rose. The duff layer of eucalyptus leaves is thick. Portions of this site are on steep slopes. A large patch of toyon is present. Native species occurring on the periphery of the stand that could be salvaged or avoided are blue-blossom ceanothus, toyon, poison-oak, Douglas' iris, golden yarrow, California blackberry, bracken fern, and horsetail. A foot trail to Fort Point traverses the site. The site should be restored to coastal scrub. The toyon stand should be avoided, if possible. The duff layer should be removed. Erosion on steep slopes should be controlled. Weeds should be controlled, especially English ivy and German ivy. Apple and pepper trees in this stand are not expected to cause restoration problems and should be retained for their historic resource values.

Stands A67, A68, C69, C65 (Portions), P66, P385, E503, and A363

These sites, along Infantry Terrace Road, support a variety of non-native tree species in a northeast facing canyon. Stand A68, in the moist canyon bottom, supports a mix of acacia, Monterey pine, and other ornamental trees with a dense understory. Stands on the canyon slope support eucalyptus, Monterey cypress, Monterey pine, acacia, and other ornamental trees with a generally more open understory. Problem weeds include German ivy, English ivy, and Himalaya berry. All these stands should be restored to coastal scrub habitat. Erosion control measures must be strictly followed on the steep slopes at these sites. Heritage Landmark Tree #1 (a Monterey cypress bearing a memorial plaque should be retained and protected.

Stand E519 (Southwestern Edge)

This site supports eucalyptus forest on northeast facing coastal slopes below Battery East. This site should be restored to coastal scrub. Freshly cut eucalyptus stumps should be painted with systemic herbicide to prevent resprouting. Historic allee trees along Andrews Road should be retained and protected.

Stands P533 and P532

These two stands of Monterey pine along Wedemeyer Street should be restored to dune scrub habitat. Duff should be removed and soil pH corrected.

Stand P536 and P499

These two stands of Monterey pine are on the lawn surrounding the Public Health Services Hospital. These sites could be restored to dune scrub.

Stand P530

This young stand of Monterey pine, east of the Public Health Services Hospital parking lot, is expanding and replacing existing dune scrub and ice plant habitats. The site should be restored to dune scrub.

Stand CP537

This site supports Monterey pine and cypress along Lincoln Boulevard at the southwestern corner of the Presidio. Ice plant is a weed problem here. The site should be restored to dune scrub.

CITATIONS

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Appendix I. Rare Plant Enhancement Recommendations

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Rare Plant Enhancement Recommendations

INTRODUCTION AND OBJECTIVES

The Presidio of San Francisco (Presidio) supports an unusually high number of rare plant species because of its unique combinations of climate and soil conditions. Eleven rare plant species are known to occur, with at least one other rare plant species known to have been extirpated. Chapter 3 of the Presidio forest management plan contains descriptions of these special-status plants at the Presidio. Most of the native vegetation of the Presidio has been removed. The remaining patches of native vegetation are mostly small, scattered, and degraded by disturbance and invasive non-native plants. With so little habitat remaining, it is surprising that populations of rare species are still represented at the Presidio. Rare plant populations that remain are small and scattered.

This report identifies actions that can be taken to enhance populations of five rare plants of the Presidio. These five species are:

- Raven's manzanita (*Arctostaphylos hookeri* var. *ravenii*),
- Presidio clarkia (*Clarkia franciscana*),
- Marin dwarf flax (*Hesperolinon congestum*),
- San Francisco lessingia (*Lessingia germanorum*), and
- San Francisco campion (*Silene verecunda* var. *verecunda*).

Enhancement of populations of these species is dependent on properly managing existing populations and expanding the amount of suitable habitat for the establishment, growth, and reproduction of new populations. Raven's manzanita, Presidio clarkia, and Marin dwarf flax grow on serpentine soils. San Francisco lessingia and San Francisco campion grow on dune soils. Expanding and managing habitat for the benefit of these five species is the key objective of this report, with the goal of increasing the number and size of populations of each species to the greatest amount possible given the existing land use constraints at the Presidio.

The actions proposed in this plan are consistent with the requirements of the federal Endangered Species Act, Raven's Manzanita Recovery Plan (U.S. Fish and Wildlife Service 1984), and the National Park Service's Management Policies (1988) and Natural Resource Management Guidelines (National Park Service 1977). U.S. Fish and Wildlife Service (USFWS) coordination will occur prior to implementation of any of the recommended actions in this report that could potentially affect federally listed threatened or endangered species.

RAVEN'S MANZANITA

Distribution and Status

Raven's manzanita, also known as Presidio manzanita, is a prostrate evergreen shrub in the heath family (Ericaceae). It grows 10-30 centimeters (cm) tall, with round leaves and white to pinkish urn-shaped flowers in compact inflorescences of 6-10 flowers (Natural Diversity Data Base 1988).

Raven's manzanita was federally listed as endangered in 1978 and state listed as endangered in 1979. The California Native Plant Society lists it as rare and endangered (List 1B) (Skinner and Pavlik 1994).

Raven's manzanita is known from a single wild plant and cuttings taken from this individual and planted at the Presidio (Natural Diversity Data Base 1994, Jones & Stokes Associates 1990). Currently, 24 plants have been established from cuttings.

Historically, populations occurred at Mount Davidson Park, Old Laurel Hill Cemetery, and Old Masonic Cemetery in what are now developed areas of San Francisco (Natural Diversity Data Base 1994).

Competition from introduced Monterey pine and ice plant and the accumulation of pine duff are present threats to Raven's manzanita (Natural Diversity Data Base 1994).

Habitat Requirements

Raven's manzanita grows on shallow, rocky serpentine soils in the cool, moist coastal setting of the San Francisco Peninsula. The occurrence of serpentine soils on coastal bluffs is unusual. Raven's manzanita in its natural condition probably occurred as a subdominant or codominant shrub in serpentine chaparral. Other likely dominant shrubs were toyon, blue-blossom ceanothus, and coyote brush. Raven's manzanita does not tolerate shade, and full sunlight appears to be essential to its survival (U.S. Fish and Wildlife Service 1984). Cuttings from the wild plant have been planted in serpentine chaparral and serpentine grassland communities (Natural Diversity Data Base 1988, 1994). Sites that support serpentine grassland are not likely to be suitable for Raven's manzanita. In inland areas on the San Francisco Peninsula, serpentine outcrops with shallow soils were the likely habitat of Raven's manzanita.

Propagation

Raven's manzanita is self-compatible, and the lone wild plant produces fruits and seeds (U.S. Fish and Wildlife Service 1984). Mature plants produce seeds; however, generation of

plants from these seeds has been unsuccessful. Seed produced is all from the single wild plant or its clones and therefore results from selfing or asexual reproduction. Spreading stems take root naturally, and Raven's manzanita can be effectively propagated from cuttings. Cuttings should be treated with 0.8% IBA (indolebutyric acid, a synthetic plant hormone that promotes root development) in talcum powder and planted in pumice with 1/8-inch of sifted gravel on a moist bench (Forbes pers. comm.). About a 50% success rate can be achieved with this method and using mature tip cuttings (Forbes pers. comm.). Rooted cuttings, established in a nursery, can be used for outplanting. Raven's manzanita can be grown in serpentine or nonserpentine soils (U.S. Fish and Wildlife Service 1984, McCarten 1986, Natural Diversity Data Base 1988). The pH of serpentine soils on which the one wild plant grows was measured at 5.9-6.0. Because serpentine soils tend to be basic, an occasional dose of weak acid is recommended for plants in cultivation that are declining in vigor. (U.S. Fish and Wildlife Service 1984.)

Clones originating from the one wild Raven's manzanita are grown in cultivation at the East Bay Regional Parks Botanical Garden; Strybing Arboretum; and University of California, Berkeley Botanical Garden.

Raven's manzanita may hybridize with other manzanitas and all attempts to produce seed should be conducted in complete isolation from plants of other manzanita species. Seedlings of "Raven's manzanita" provided at native plant sales may be of hybrid origin (U.S. Fish and Wildlife Service 1984).

Because Raven's manzanita is limited to a single known genotype, all propagules will be clones or inbred offspring of this individual. Expanding the genetic variation of Raven's manzanita is dependent on:

- chance mutations in offspring from the existing plant or its clones,
- discovery of new plants,
- collection and germination of seeds from the serpentine soil seed bank located a distance from the existing plant, or
- collection and germination of seeds from the herbarium specimens.

Finding and germinating seeds likely is the fastest way to increase genetic variation. Soil samples should be collected from sites that likely supported Raven's manzanita in the past. Various methods should be tried to find and germinate manzanita seed from these samples. For example, the soil samples could be spread and watered to germinate all viable seeds and search for manzanita seedlings; fire, or heat to imitate fire, could be used to induce germination; seeds could be sifted from the soil, potential manzanita seeds collected, and various scarification or other germination enhancement techniques could be used on them.

Existing Management and Recovery Plans

The National Park Service (NPS) has prepared an action plan for management and enhancement of the existing population of Raven's manzanita at the Presidio (Farrell 1994). The actions recommended in this plan focus on protecting the existing natural plant and plants established from cuttings from aggressive weeds, planted trees, and human disturbance.

The USFWS prepared a recovery plan for Raven's manzanita that has not been implemented (U.S. Fish and Wildlife Service 1984). This plan recommended the following actions:

- remove introduced trees and ice plant from the immediate vicinity of the lone wild plant;
- propagate new individuals from vegetative stock and seed;
- conduct new studies of species biology and ecology, including best planting methods, new ways to increase available seed, and habitat management methods; and
- establish new populations on serpentine soils at the Presidio.

A study of the ecological aspects of Raven's manzanita related to recovery was prepared by McCarten (1986). This report included the following key findings:

- additional studies of habitat requirements, especially plant-water relations, are needed;
- additional material for establishing new populations needs to be propagated; and
- populations should be established at sites that historically supported the species.

The NPS restoration project action plan for Raven's manzanita provides the following recommendations for enhancing this population:

- control aggressive weeds, particularly ice plant and German ivy, and surrounding trees and other non-native plants;
- control public access through trail removal, fencing, and signs, to prevent trampling;
- restore native serpentine plant species;
- implement the Raven's Manzanita Recovery Plan (U.S. Fish and Wildlife Service 1984); and
- monitor the success of enhancement efforts (Farrell 1994).

Habitat and Population Enhancement Recommendations

The number of Raven's manzanita plants can be increased by expanding suitable habitat at sites on the coastal bluffs.

The west-facing coastal bluffs between Battery Crosby and Fort Point and the north-facing bluffs support a mix of soil types that include serpentine soils. Most of the bluffs support bluff scrub and coastal scrub habitats dominated by native species of shrubs. To enhance the coastal bluff for Raven's manzanita, the following steps should be taken:

- identify sites with suitable serpentine soils for serpentine chaparral;
- identify sites, from those with suitable soils, that support non-native species as the dominant or a major component of the vegetative cover;
- clear non-native species and thin native species, leaving exposed sites for revegetation;
- plant rooted cuttings of Raven's manzanita in openings with full sun and sufficient open surface for expansion;
- fence or otherwise restrict human access to the restoration sites;
- remove all plants that establish near or encroach on the manzanita plantings for at least 5 years after restoration.

Where forest stands are removed from sites with serpentine soils, Raven's manzanita can be established in the restored serpentine chaparral. Restoration methods for serpentine chaparral at these sites are described in Appendix H.

PRESIDIO CLARKIA AND MARIN DWARF FLAX

Enhancement recommendations for Presidio clarkia and Marin dwarf flax are presented together because of the similar propagation and habitat requirements of these two small, annual species.

Distribution and Status of Presidio Clarkia

Presidio clarkia is a herbaceous annual in the evening primrose family (Onagraceae). This slender, erect plant can reach 4 cm in height, with few small narrow leaves and four broad lavender-pink petals. The petals are 5-15 millimeters (mm) long with irregular teeth on the

margin of the apex (Hickman 1993, California Department of Fish and Game 1992, Natural Diversity Data Base 1988).

Presidio clarkia was federally listed as endangered in March 1995 and state listed as endangered in 1978 (California Department of Fish and Game 1997). It is listed by the California Native Plant Society as rare and endangered (List 1B) (Skinner and Pavlik 1994).

Five populations of Presidio clarkia are known to occur in San Francisco and Alameda Counties. Two populations occur at the Presidio (Natural Diversity Data Base 1994, Jones & Stokes Associates 1990). Three other populations are found in the Oakland hills in Alameda County (Natural Diversity Data Base 1994).

Presidio clarkia's historical distribution included a third population at the Presidio (Natural Diversity Data Base 1994).

At the Presidio, threats to the populations are road maintenance; competition from non-native trees, shrubs, and grasses; and trampling by pedestrians. In the Oakland hills, horse trails, proposed development, and non-native plant species pose a threat to populations (Natural Diversity Data Base 1994).

Distribution and Status of Marin Dwarf Flax

Marin dwarf flax is a herbaceous annual in the flax family (Linaceae). It grows 5-15 cm tall with thread-like to linear leaves. Flowers are white or partly pink and occur in congested clusters with pubescent sepals and five rose to whitish petals (Hickman 1993, Niehaus 1977).

Marin dwarf flax was federally listed as threatened in March 1995 and state listed as threatened in 1992 (California Department of Fish and Game 1997). It is listed as rare and endangered (List 1B) by the California Native Plant Society (Skinner and Pavlik 1994).

Existing populations of the Marin dwarf flax occur from Marin County to San Mateo County (California Department of Fish and Game 1992, Natural Diversity Data Base 1994). Two populations occur in Marin County near Pine Mountain. Five populations occur on the ridge of the Tiburon Peninsula. Two populations are recorded from the Presidio; however, one of these populations has not been seen in recent years and the other appears to be California dwarf flax (*Hesperolinon californicum*), a common species. The six populations in San Mateo County represent the largest and most significant populations of the species (California Department of Fish and Game 1992).

The historical range of Marin dwarf flax included at least five additional populations occurring in several areas: near Tiburon, at old Laurel Hill Cemetery just south of the Presidio, at Mount Davidson Park in San Francisco, near Crystal Springs in San Mateo County, and at what is now the Emerald Hills Golf Course in San Mateo County.

As a result of residential development and construction of roads and freeways, 25% of the historically known populations of Marin dwarf flax have been lost (California Department of Fish and Game 1992). Four populations in Marin County occur on private lands that may be developed. Other threats to populations are invasive non-native species, biking, hiking, erosion, and dumping (Natural Diversity Data Base 1994).

Habitat Requirements

At the Presidio, Presidio clarkia and Marin dwarf flax occur in open serpentine habitat within serpentine chaparral and serpentine grassland. This habitat is designated "serpentine barren" in this report. Serpentine barren occurs on steep slopes, along road cuts, and on sites where surface soil has been removed.

Presidio clarkia populations in the Oakland hills occur on serpentine outcrops in grassland and coastal scrub habitats (Natural Diversity Data Base 1994).

In Marin and San Mateo Counties, populations of Marin dwarf flax are found on serpentine soils in openings in serpentine bunchgrass and serpentine chaparral habitats (California Department of Fish and Game 1992, Natural Diversity Data Base 1994, Niehaus 1977).

Propagation

Presidio clarkia and Marin dwarf flax can be propagated from seed (Roof 1971, 1972; Natural Diversity Data Base 1994). A small amount of seed should be collected from wild plants, germinated, and grown in a nursery. Dwarf flax and clarkia can be grown from seed in a well-drained soil mixture with no special germination treatments (Forbes pers. comm.). Nursery-grown plants should be cross-pollinated by hand. Seed from nursery plants would be used to establish new populations and to maintain nursery stock for seed production. Clarkia seed can be stored for 5 or more years and remain viable (Roof 1971).

Habitat and Population Enhancement Recommendations

Suitable serpentine soils for enhancement of Presidio clarkia and Marin dwarf flax are of limited extent at the Presidio. Serpentine barren occurs on north- and west-facing coastal bluffs and near Inspiration Point. New areas of serpentine barren can be created where vegetation is cleared for the establishment of Raven's manzanita, as described above. Additional areas should be available where forest stands are removed from serpentine soils. Restoration of serpentine grassland and serpentine chaparral at forest removal sites is described in Appendix H. Serpentine soils also occur at the Presidio Golf Course. The southeast portion of this area of serpentine soils

may support natural vegetation and could be a suitable site for establishing new populations of Presidio clarkia and Marin dwarf flax.

Open barrens within serpentine chaparral and grassland should be seeded with Presidio clarkia and Marin dwarf flax. Seed for this purpose should be propagated at the Presidio native plant nursery or other qualified nursery. New population sites should be chosen that support microhabitat similar to microhabitat conditions at existing populations. These conditions are expected to be mostly bare serpentine rock with pockets of developed soil or areas with thin serpentine soils and a sparse vegetative cover. New populations of dwarf flax and clarkia were established at the Presidio from seed by James Roof (Natural Diversity Data Base 1994). Seeding locations should be well marked and protected from disturbance. Monitoring of establishment and reproduction should be conducted for new populations.

SAN FRANCISCO LESSINGIA AND SAN FRANCISCO CAMPION

Enhancement recommendations for San Francisco lessingia and San Francisco campion are presented together because of the similar propagation and habitat requirements of these two species.

Distribution and Status of San Francisco Lessingia

San Francisco lessingia is an annual in the sunflower family (Asteraceae). It grows 1-3 cm tall with slender diffusely branching stems. The flower heads have 20-40 flowers (Hickman 1993). The corolla is deep lemon-yellow with a brownish or purplish band at the throat (Abrams 1964, Hickman 1993).

San Francisco lessingia was federally listed as endangered in 1997. It was state listed as endangered in 1990 (California Department of Fish and Game 1992). The California Native Plant Society lists it as rare and endangered (List 1B) (Skinner and Pavlik 1994).

Existing populations of San Francisco lessingia are found in San Francisco and San Mateo Counties (Natural Diversity Data Base 1994). The five populations in San Francisco County are at the Presidio, with one of these populations artificially established (Jones & Stokes Associates 1990). A population occurs in Daly City, on the west side of San Bruno Mountain (Natural Diversity Data Base 1994).

The historical range of San Francisco lessingia is known to have included two other populations: one at the site of the present Harding Park Municipal Golf Course and the other at the present Mount Davidson Park. Prior to urban development, lessingia likely occurred in coastal dune scrub throughout the San Francisco Peninsula (59 FR 191: 50550, October 4, 1994).

The threats to the populations at the Presidio result from recreational activities such as trampling by pedestrians, pets, and bicycles. The encroachment of ice plant and annual grasses pose threats to these populations. The San Bruno Mountain population is threatened by slope stabilization projects. Destruction of habitat has been the primary cause of the present low population numbers (Natural Diversity Data Base 1988).

Distribution and Status of San Francisco Campion

San Francisco campion is a herbaceous perennial in the pink family (Caryophyllaceae). It has opposite leaves and few to several erect or ascending stems 1-5 cm tall arising from a branched caudex (an upright, subterranean stem). Basal leaves are narrowly to broadly oblanceolate, 2-6 cm long, and 2-10 mm wide. The sepals are united into a tubular calyx with five teeth, and the narrow base of the five petals are attached to the top of the ovary stalk. Petals are pink to rose and oblong with notched tips. (Young 1979, Hickman 1993.)

The California Native Plant Society lists San Francisco campion as rare and endangered (List 1B) (Skinner and Pavlik 1994).

The existing distribution of San Francisco campion encompasses several locations in San Francisco, San Mateo, and Santa Cruz Counties (Young 1979, Jones & Stokes Associates 1990, Natural Diversity Data Base 1994). Two occurrences are at the Presidio. One population occurs at Mount Davidson Park and another at San Bruno Mountain State and County Park. One population occurs at Edgewood County Park. Six populations are known from along the Santa Cruz County coast. A small population reported from Sutter County is most likely a misidentification (Natural Diversity Data Base 1994).

Historically, San Francisco campion ranged near the coast of central California from San Francisco to San Luis Obispo County (Abrams 1968, Jones & Stokes Associates 1990).

Housing and commercial development resulted in the loss of the populations known from Lake Merced and Mission Dolores in San Francisco, while development, grazing, and sand mining threaten southern populations (Young 1979, Natural Diversity Data Base 1994). A population in Santa Cruz County is adjacent to a turnout and thus vulnerable to trampling (Natural Diversity Data Base 1994). The population at Mount Davidson is threatened by the encroachment of blue gum eucalyptus, Scotch broom, and German ivy. Park development at Edgewood County Park may adversely affect the population there. The populations at the Presidio are threatened by competition from ice plant, shading by Monterey cypress, and pedestrian trampling.

Habitat Requirements

San Francisco lessingia and San Francisco campion occur in coastal dune habitats. These species are typically found in open sites within dune scrub. Disturbance of the sandy substrate is likely necessary to open habitat for these species. Full sun and open sandy substrate are key elements to survival. Lessingia is an early colonizer of bare sand in disturbance patches with dune scrub. Neither species is a good competitor for space and as vegetative cover increases over time, habitat suitability for lessingia and campion declines. New sites must be opened by disturbance to allow these species to persist.

Microhabitat requirements and tolerance differ between lessingia and campion. Lessingia is restricted to open sandy habitats. Because it is a perennial, San Francisco campion may be able to persist for longer periods than the annual lessingia, as vegetative cover increases in the dune scrub. Throughout its range, campion occurs on a wider variety of substrates than does lessingia, including open sand, mudstone, shale, sandstone, and serpentine (Natural Diversity Data Base 1994). Populations of San Francisco campion in San Mateo and Santa Cruz Counties occur in sandy openings within dune scrub; in well-drained sandy to rocky soils in coastal strand, coastal prairie, and north coastal scrub habitats; and have been reported in serpentine grassland (Natural Diversity Data Base 1994, Young 1979). At the Presidio, campion has been found only on open sand in dune scrub.

Propagation

San Francisco lessingia is an annual. San Francisco campion is a perennial from a branched caudex (upright, subterranean stem). Both should be readily propagated from seed. A small amount of seed should be collected from wild plants, germinated, and grown in a nursery. Nursery-grown plants should be cross-pollinated by hand. Seed from nursery plants would be used to establish new populations and to maintain nursery stock for seed production. Campion can be grown from seed in the nursery and resulting whole plants installed at restoration sites.

Existing Management and Recovery Plans

Action plans have been prepared by NPS for management and enhancement of the five existing populations of San Francisco lessingia (Farrell 1994). Key recommendations in these action plans are to:

- control non-native weedy species, especially ice plant and annual grasses;
- protect populations from pedestrian trampling by fencing, removing trails, and installing signs;

- remove surrounding non-native trees;
- revegetate with native plants; and
- monitor success of enhancement actions (Farrell 1994).

Habitat and Population Enhancement Recommendations

To protect and enhance existing populations of San Francisco lessingia and campion, aggressive weeds and natural vegetative closure of dune scrub must be controlled. Areas of open sand in full sun need to be maintained to provide sites for seedling establishment.

Monterey cypress should be cleared from around the existing campion population. Trees within the population should be removed. Trees bordering the population should be pruned to allow a greater area to be exposed to full sun. Additional campion plants and native shrubs (Chamisso lupine and coast buckwheat) should be planted in unvegetated areas exposed to the sun by tree removal. Ice plant should be removed by hand from within the campion population and from surrounding areas, and ice plant duff should be raked from the site. Access to this campion population should be restricted.

The key to establishing new populations of lessingia and campion is the proper management of dune scrub habitat to allow for disturbance patches that expose the sandy substrate. These openings need to be large enough to delay closure of the vegetative cover long enough to allow lessingia and campion populations to establish and survive through several generations. The openings should not be so large that the dune becomes destabilized. Sites supporting existing populations of lessingia and campion range in size from about 0.2 acre to 0.8 acre. Because habitat value at most of these sites is rapidly declining from invading vegetation, a reasonable size range for new lessingia and campion habitat may be between 0.5 and 1.0 acre. These disturbance patches should not be created on sites highly susceptible to water or wind erosion.

Successful enhancement of lessingia and campion populations would best be accomplished through a dynamic habitat management program, rather than intensive hand-weeding of existing populations. New sites would be cleared of dune scrub in areas surrounding endangered populations to create new habitat for these rare species. Habitat that supports populations of lessingia and campion would then be allowed to degrade, that is, progress into mature native dune scrub. Habit[illegible]ing lessingia and campion would be managed intensively, however, until such time as new populations become established under a less intensive management program.

The habitat management program must begin with a sufficient amount of dune scrub habitat to allow for creation of a mosaic of seral stages. Expected restoration of dune scrub habitat at forest removal sites and non-native habitat sites at the Presidio allow for a substantial expansion of dune scrub habitat. Appendix H contains a description of dune scrub restoration

methods. Dune scrub restoration should include seeding of lessingia and campion. Microhabitat suitable for lessingia and campion should be extensive at new dune scrub restoration sites because of the low initial vegetative cover. As dune scrub establishes at restoration sites, lessingia and campion habitat will degrade. Patches of mature dune scrub will need to be "reset" to early successional stages by artificial disturbance. Early successional stages of dune scrub will provide lessingia and campion habitat. Lessingia and campion should be given several years to recolonize these new sites. If recolonization does not occur, then these species could be artificially established with propagated seed.

Long-term management of the dune scrub would include occasional mechanical clearing of patches of vegetation to create new areas of early successional dune scrub and lessingia and campion habitat. Natural events, such as storms that destabilize the dunes, can be incorporated into the management of dune scrub. However, the limited extent of dune scrub habitat and the surrounding land uses severely restrict the amount of natural disturbance that can be allowed. Controlled, artificial disturbance should be the primary method of lessingia and campion habitat enhancement.

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Appendix J. Common and Scientific Names of Plants Mentioned in the Presidio Natural Resource Inventory

Common and Scientific Names of Plants Mentioned in the Presidio Natural Resource Inventory

Common Name	Scientific Name
Albizia	*Albizia lophantha*
American dogwood	*Cornus sericea*
American vetch	*Vicia americana* ssp. *americana*
Andean pampas grass	*Cortaderia jubata*
Arborescent red elderberry	*Sambucus racemosa*
Arroyo willow	*Salix lasiolepis*
Australian fireweed	*Erectites glomerata*
Avocado	*Persea americana*
Bailey acacia	*Acacia baileyana*
Baltic rush	*Juncus balticus*
Beach-bur	*Ambrosia chamissonis*
Beach knotweed	*Polygonum paronychia*
Beach primrose	*Camissonia cheiranthifolia*
Beach saltbush	*Atriplex leucophylla*
Beach strawberry	*Fragaria chiloensis*
Beauty cinquefoil	*Potentilla gracilis*
Bermuda buttercup	*Oxalis pes-caprae*
Bermuda grass	*Cynodon dactylon*
Bicolored lupine	*Lupinus bicolor*
Big leaf maple	*Acer macrophyllum*
Bigelow's microseris	*Microseris bigelovii*
Black acacia	*Acacia melanoxylon*
Black mustard	*Brassica nigra*
Black twinberry	*Lonicera involucrata* var. *ledebourii*
Black walnut	*Juglans hindsii*
Bleeding heart	*Dicentra formosa*
Blue-blossom ceanothus	*Ceanothus thyrsiflorus*
Blue dicks	*Dichelostemma capitatum*
Blue-eyed grass	*Sisyrinchium bellum*
Blue gum eucalyptus	*Eucalyptus globulus*
Blue toadflax	*Linaria canadensis*
Blue wildrye	*Elymus glaucus*
Blue witch	*Solanum umbelliferum*
Beefwood	*Grevillea striata*

Common Name	Scientific Name
Bottlebrush	*Callistemon rigidus*
Box elder	*Acer negundo* ssp. *californicum*
Bracken fern	*Pteridium aquilinum* var. *pubescens*
Branching phacelia	*Phacelia ramosissima* var. *ramosissima*
Broadleaf sun cups	*Camissonia ovata*
Brooklime	*Veronica americana*
Brown-headed rush	*Juncus phaeocephalus*
Brush cherry	*Syzigium paniculatum*
Bugle hedgenettle	*Stachys ajugoides*
Bush lupine	*Lupinus arboreous*
Bush monkeyflower	*Mimulus aurantiacus*
California acaena	*Acaena pinnatifida* var. *californica*
California aster	*Aster chilensis*
California barberry	*Berberis pinnata*
California bay laurel	*Umbellularia californica*
California beaked hazelnut	*Corylus cornata* var. *californica*
California blackberry	*Rubus ursinus*
California brome	*Bromus carinatus*
California buckeye	*Aesculus californica*
California bulrush	*Scirpus californicus*
California buttercup	*Ranunculus californicus*
California club-rush	*Scirpus cernuus*
California coast phacelia	*Phacelia californica*
California coffeeberry	*Rhamnus californica*
California croton	*Croton californicus*
California figwort	*Scrophularia californica*
California goldflields	*Lasthenia chrysostoma*
California goosefoot	*Chenopodium californicum*
California hedge-nettle	*Stachys bullata*
California honeysuckle	*Lonicera hispidula*
California maidenhair fern	*Adiantum jordanii*
California man-root	*Marah fabaceus*
California melic grass	*Melica californica*
California oatgrass	*Danthonia californica*
California pepper	*Schinus molle*
California pipestem clematis	*Clematis ligusticifolia*
California plantain	*Plantago erecta*
California polypody fern	*Polypodium californicum*
California poppy	*Eschscholzia californica*
California sagebrush	*Artemisia californica*
California spikenard	*Aralia californica*
California wax myrtle	Myrica californica

Common Name	Scientific Name
California strawberry	*Fragaria vesca*
California wild rose	*Rosa californica*
California wood fern	*Dryopteris arguta*
Canary Island Date palm	*Phoenix canariensis*
Casuarina	*Casuarina* sp.
Catchweed bedstraw	*Galium aparine*
Cedar	*Cedrus* sp.
Celery-leaved lovage	*Ligusticum apiifolium*
Chamisso lupine	*Lupinus chamissonis*
Checker bloom	*Sidalcea malvaeflora*
Checker-lily	*Fritillaria affinis*
Cheeseweed	*Malva nicaeensis*
Chile lotus	*Lotus wrangelianus*
Chinese elm	*Ulmus parvifolia*
Coast buckwheat	*Eriogonum latifolium*
Coast cryptantha	*Cryptantha leiocarpa*
Coast goldenrod	*Solidago spathulata*
Coast live-forever	*Dudleya farinosa*
Coast live oak	*Quercus agrifolia*
Coast redwood	*Sequoia sempervirens*
Coast rock cress	*Arabis blepharophylla*
Coastal sagewort	*Artemisia pycnocephala*
Coastal saltgrass	*Distichlis spicata*
Coastal paintbrush	*Castilleja affinis*
Coastal sand-verbena	*Abronia latifolia*
Common lomatium	*Lomatium utriculatum*
Common rush	*Juncus effusus*
Common soap plant	*Chlorogalum pomeridianum*
Common streamside monkeyflower	*Mimulus guttatus*
Common toad rush	*Juncus bufonius* var. *bufonius*
Corkscrew willow	*Salix matsudana 'Tortuosa'*
Cotoneaster	*Cotoneaster* spp.
Cotton-batting plant	*Gnaphalium stramineum*
Cow-parsnip	*Heracleum lanatum*
Cows clover	*Trifolium wormskioldii*
Coyote brush	*Baccharis pilularis*
Creeping wildrye	*Leymus triticoides*
Croton	*Croton californicus*
Cryptomeria	*Cryptomeria japonica 'Elegans'*
Date palm	*Phoenix dactylifera*

Common Name	Scientific Name
Davy's centaury	*Centaurium davyi*
Deerweed	*Lotus scoparius*
Dense sedge	*Carex densa*
Deodar Cedar	*Cedrus deodara*
Dichondra	*Dichondra donnelliana*
Douglas bluegrass	*Poa douglasii*
Douglas fir	*Pseudotsuga menziesii*
Douglas iris	*Iris douglasiana*
Douglas microseris	*Microseris douglasii*
Douglas nightshade	*Solanum douglasii*
Douglas water hemlock	*Circuta douglasii*
Dracaena palm	*Cordyline australis*
Dune bentgrass	*Agrostis pallens*
Dune gilia	*Gilia capitata* var. *chamissonis*
Dune tansy	*Tanacetum camphoratum*
Dwarf brodiaea	*Brodiaea terrestris*
Elderberry	*Sambucus racemosa*
Elegant bog orchid	*Piperia elegans*
Elegant harvest brodiaea	*Brodiaea elegans*
Elongated selfheal	*Prunella vulgaris* var. *lanceolata*
English ivy	*Hedera helix*
English oak	*Quercus robur*
Erect evax	*Hesperevax sparsiflora*
Eucalyptus species	*Eucalyptus* sp.
European beach grass	*Ammophila arenaria*
Everlasting pea	*Lathyrus latifolius*
Fennel	*Foeniculum vulgare*
Few-seeded bitter-cress	*Cardamine oligosperma*
Filaree	*Erodium* spp.
Foothill needlegrass	*Nassella lepida*
Franciscan thistle	*Cirsium andrewsii*
French broom	*Genista monspessulana*
German ivy	*Senecio mikanioides*
Giant black vetch	*Vicia gigantea*
Giant horsetail	*Equisetum telemateia*
Giant reed grass	*Arundo donax*
Giant sequoia	*Sequoiadendron giganteum*
Gilia	*Gilia capitata*
Glossy Privet	*Ligustrum lucidum*
Goldback fern	*Pentagramma triangularis*
Golden yarrow	*Eriophyllum staechadifolium* var. *artemisiifolium*

Common Name	Scientific Name
Gorse	*Ulex europaea*
Hairy woodrush	*Luzula comosa*
Himalaya berry	*Rubus discolor*
Heather goldenbush, mock heather	*Ericameria ericoides*
Henderson's angelica	*Angelica hendersonii*
Hill morning-glory	*Calystegia subacaulis*
Hoary nettle	*Urtica dioica* ssp. *holosericea*
Hollyleaf cherry	*Prunus ilicifolia*
Honey locust	*Gleditsia triacanthos*
Hooded ladies' tresses	*Spiranthes romanzoffiana*
Hooked-spur violet	*Viola adunca*
Hooker evening primrose	*Oenothera elata* var. *hookeri*
Hooker fairy bells	*Disporum hookeri*
Hyssop loosestrife	*Lythrum hyssopifolium*
Ice plant	*Carpobrotus edulis*
Imbricated sword-fern	*Polystichum imbricans* var. *imbricans*
Italian ryegrass	*Lolium multiflorum*
Ithuriel's spear	*Triteleia laxa*
Junegrass	*Koeleria macrantha*
Kelp	*Polygonum amphibium* var. *emersum*
Lady fern	*Athyrium filix-femina*
Largeleaf Puget-Sound gumplant	*Grindelia stricta*
Lizard tail	*Eriophyllum staechadifolium* var. *artemisiafolium*
Leopard lily	*Lilium pardalinum*
Locust	*Robinia pseudoacacia*
Lombardy poplar	*Populus nigra 'Italica'*
London plane	*Platanus acerifolia*
Long-petaled iris	*Iris longipetala*
Low barley	*Hordeum depressum*
Maidenhair vine	*Muhlenbeckia complexa*
Manycolored lupine	*Lupinus variicolor*
Marin dwarf flax	*Hesperolinon congestum*
Maritime pine	*Pinus pinaster*
Mediterranean barley	*Hordeum geniculatum*
Menzies' fiddleneck	*Amsinckia menziesii*
Mexican fan palm	*Washingtonia robusta*
Mexican plantain	*Plantago subnuda*
Mexican rush	*Juncus mexicanus*
Milk-maids	*Cardamine californica*
Miner's lettuce	*Claytonia perfoliata*
Mock heather	*Ericameria ericoides*
Leptospermum (tea tree)	Leptospermum
Melaleuca	Melaleuca

Common Name	Scientific Name
Monterey cypress	*Cupressus macrocarpa*
Monterey pine	*Pinus radiata*
Moreton Bay fig	*Ficus macrophylla*
Mugwort	*Artemisia douglasiana*
Myporum	*Myoporum laetum*
Naked broom-rape	*Orobanche uniflora*
Narrow-leaf ice plant	*Conicosia pugioniformis*
Narrowleaf mule-ear's	*Wyethia angustifolia*
Nasturtium	*Tropaeolum majus*
New Zealand Christmas tree	*Araucaria excelsa*
Oak thistle	*Cirsium quercetorum*
Ookow	*Dichelostemma congestum*
Osoberry	*Oemleria cerasiformis*
Pacific blackberry	*Rubus ursinus*
Pacific madrone	*Arbutus menziesii*
Pacific peavine	*Lathyrus vestitus*
Pacific sanicle	*Sanicula crassicaulis*
Pacific seaside plantain	*Plantago maritima*
Pacific wax myrtle	*Myrica californica*
Pampas grass	*Cortaderia jubata*
Pannicled willow-herb	*Epilobium brachicarpum*
Pearly everlasting	*Anaphalis margaritacea*
Perennial ryegrass	*Lolium perenne*
Periwinkle	*Vinca major*
Pink everlasting	*Gnaphalium ramosissimum*
Pink ironbark	*Eucalyptus sideroxylon*
Pink sand-verbena	*Abronia umbellata*
Pittosporum	*Pittosporum* sp.
Plains evening primrose	*Camissonia contorta*
Poison oak	*Toxicondendron diversilobum*
Poplar	*Populus* sp.
Presidio clarkia	*Clarkia franciscana*
Prostrate blue-blossom ceanothus	*Ceanothus thyrsiflorus* var. *repens*
Prostrate soap plant	*Chlorogalum pomeridianum* var. *divaricatum*
Purple clover	*Trifolium depauperatum*
Purple everlasting	*Gnaphalium purpureum*
Purple mission bells	*Fritillaria lanceolata*
Purple needlegrass	*Nassella pulchra*
Purple sanicle	*Sanicula bipinnatifida*
Pygmy-weed	*Crassula connata*
Rattlesnake grass	*Briza maxima*

Common Name	Scientific Name
Red elderberry	*Sambucus racemosa*
Rattlesnake weed	*Daucus pusillus*
Raven's manzanita	*Arctostaphylos hookeri* var. *ravenii*
Red alder	*Alnus rubra*
Red fescue	*Festuca rubra*
Red flowering gum	*Eucalyptus ficifolia*
Redmaids	*Calandrinia ciliata*
Red valerian	*Centranthus ruber*
Red willow	*Salix lucida* ssp. *lasiandra*
Ripgut brome	*Bromus diandrus*
River red gum	*Eucalyptus camaldulensis*
Rosilla sneezeweed	*Helenium puberulum*
Rough horsetail	*Equisetum hyemale* var. *affine*
Rough-leaved aster	*Aster radulinus*
Salt rush	*Juncus lesueurii*
San Francisco campion	*Silene verecunda* var. *verecunda*
San Francisco gumplant	*Grindelia hirsutula* var. *maritima*
San Francisco lessingia	*Lessingia germanorum*
San Francisco owl clover	*Triphysaria floribunda*
San Francisco spineflower	*Chorizanthe cuspidata*
San Francisco wallflower	*Erysimum franciscanum*
Sandmat	*Cardionema ramosissimum*
Scotch broom	*Cytisus scoparius*
Scouler's polypody fern	*Polypodium scouleri*
Seaside agoseris	*Agoseris apargioides*
Seaside brome grass	*Bromus carinatus* var. *maritimus*
Seaside daisy	*Erigeron glaucus*
Seaside fiddleneck	*Amsinckia spectabilis*
Sedge	*Carex tumulicola*
Shining willow	*Salix lucida*
Short-ligule sedge	*Carex brevicaulis*
Sickle-leaved rush	*Juncus falcatus* var. *falcatus*
Sidney golden wattle	*Acacia longifolia*
Silver bush lupine	*Lupinus albifrons*
Silver dollar gum	*Eucalyptus polyanthemos*
Silverweed	*Potentilla anserina* ssp. *pacifica*
Siskiyou monardella	*Monardella villosa* var. *neglecta*
Six-weeks fescue	*Vulpia octoflora*
Sky lupine	*Lupinus nanus*
Skunkweed	*Navarretia squarrosa*
Slender hairgrass	*Deschampsia elongata*
Slender oats	*Avena barbata*
Silver bush lupine	*Ambrosia chamissonis*

Common Name	Scientific Name
Slender spike-rush	*Eleocharis acicularis*
Slough sedge	*Carex obnupta*
Small-bracted sedge	*Carex subbracteata*
Small-flowered melic grass	*Melica imperfecta*
Small primrose	*Camissonia micrantha*
Soft chess	*Bromus mollis*
Spreading rush	*Juncus patens*
Squaw root	*Perideridia kelloggii*
Sticky red flowering currant	*Ribes sanguineum* var. *glutinosum*
Stinging phacelia	*Phacelia malvifolia*
Stone pine	*Pinus pinea*
Strigose lotus	*Lotus strigosus*
Sweet cicely	*Osmorhiza chilensis*
Sweetgum	*Liquidambar styraciflua*
Sycamore	*Platanus* sp.
Three square	*Scirpus americanus*
Tidy tips	*Layia platyglossa*
Torrey melic	*Melica torreyana*
Tower mustard	*Arabis glabra*
Toyon	*Heteromeles arbutifolia*
Tufted hairgrass	*Deschampsia cespitosa*
Tulip poplar	*Liriodendron tulipifera*
Uropappus	*Uropappus lindleyi*
Vancouver wild-rye	*Leymus X vancouverensis*
Velvet grass	*Holcus lanatus*
Water-cress	*Rorippa nasturtium-aquaticum*
Water-parsley	*Oenanthe sarmentosa*
Watson's northern willow-herb	*Epilobium ciliatum* ssp. *watsonii*
Wax myrtle	*Myrica californica*
Weeping willow	*Salix babylonica*
Western bentgrass	*Agrostis exarata*
Western horseweed	*Conyza canadensis*
Western houndstongue	*Cynoglossum grande*
Western ladies-mantle	*Aphanes occidentalis*
Western morning-glory	*Calystegia occidentalis*
Western swordfern	*Polystichum munitum*
Western trillium	*Trillium ovatum*
White snowberry	*Symphoricarpus albus* var. *laevigatus*
Whorl-leaf acacia	*Acacia verticillata*
Wight's paintbrush	*Castilleja wightii*
Wild barley	*Hordeum murinum* var. *leporinum*

Common Name	Scientific Name
Wild buckwheat	*Eriogonum latifolium*
Wild ginger	*Asarum caudatum*
Wild heliotrope	*Phacelia distans*
Wild oats	*Avena fatua*
Wild onion	*Allium dichlamydeum*
Wild radish	*Raphanus sativus*
Willow dock	*Rumex salicifolius*
Woolly-fruited lomatium	*Lomatium dasycarpum*
Yarrow	*Achillea millefolium*
Yellow mats	*Sanicula arctopoides*
Yellow willow	*Salix lasiandra*
Yerba buena	*Satureja douglasii*

Appendix K. Soil Erosion Site Inventory

Soil Erosion Site Inventory

SOIL EROSION SITE INVENTORY

This report documents the results of an erosion site inventory of the Presidio conducted in 1993-1994, of which Table K-1 is a summary. The site locations are shown in Figure K-1. Sites are classified as to severity (as discussed in Chapter 3, "Forest Inventory", of the vegetation management plan), using the categories "severe", "moderate", and "minor".

The following is a description of the severely eroding sites identified in Table K-1.

SITES AROUND JULIUS KAHN PLAYGROUND

One of the most severely eroding sites, site 8, is an area just west of Julius Kahn Playground. A cypress forest planted on Sirdrak dune sand has lost 6-8 feet of soil in places, judging by the root exposure. Many trees have died and fallen over; some of those that continue to live are in extremely poor condition.

The area is clearly a conduit for heavy foot traffic that has destabilized and mechanically transported a large amount of the sandy soil downslope. Most of the sand moved seems to have been transported by running water, however, judging by the water-worn gullies and the existence of a substantial alluvial fan of sandy sediment downslope. The watershed contributing runoff to the site seems too small to result in so much sediment movement; this site exhibits the strong effect of soil hydrophobicity. An additional erosion feature of this site is an area of piping at the lower end of the alluvial fan that may result from leaking underground pipes.

Two other severely eroded sites occur directly adjacent to site 8, east and north of Julius Kahn Playground, at sites 33 and 34. Site 33 is a wide, deep gully formed by a faulty drainage system from the adjacent tennis courts. Ineffectual efforts to plug the gully with construction debris have only increased its width. Site 34 is a deep gully, eroded by foot traffic rather than by runoff, in a very small patch of native dune scrub vegetation. The gully threatens the sustainability of the dune scrub patch. Stumps indicate that the area previously supported cypress trees that died, probably from root exposure.

Table K-1. Soil Erosion Site Inventory

Erosion Site	Map Unit	Existing Soil Type	Erosion Type	Erosion Rating	Erosion Cause	Recommended Action
1	4311	Fill	Gully	Active, minor	Runoff	Remove fill, restore site
2	4111	Cronkhite	Gully, root exposure	Active, minor	Foot traffic	Redirect traffic, remove trees, stabilize soil, replant
3	4111	Cronkhite	Gully, root exposure	Active, moderate	Foot traffic	Redirect traffic, stabilize soil
4	2211	Sirdrak	Gully	Inactive, stabilized	Runoff	Maintain ground cover
5	2211	Sirdrak	Gully, root exposure	Low activity, stabilized	Runoff	Replant, maintain ground cover
6	2211	Sirdrak	Root exposure	Active, moderate	Foot traffic, hydrophobicity	Redirect traffic, remove trees, reduce runoff, stabilize soil, replant
7	2211	Sirdrak	Gully wash	Active, moderate	Runoff	Redirect drainage, reduce runoff, pave footpath
8	2211	Sirdrak	Gullies, root exposure, piping	Active, severe	Foot traffic, runoff, hydrophobicity	Redirect traffic, remove trees, regrade site, reduce runoff, stabilize soil, replant, maintain ground cover
9	2211	Sirdrak	Gully, root exposure	Active, moderate	Foot traffic, runoff, hydrophobicity	Redirect traffic, remove trees, regrade site, reduce runoff, stabilize soil, replant, maintain ground cover
10	3114	Typic ustropept	Root exposure	Active, severe	Foot traffic, runoff	Redirect traffic, remove trees, stabilize soil, replant
11	3113	Pachic haplustoll	Cut bank, root exposure	Active, moderate	Road cut	Remove trees, restore site
12	4311	Henneke (variant)	Gully	Repaired	Road drainage	Stabilize soil, restore vegetation, add new fill
13	3113	Typic ustropept	Gully	Active, minor	Foot traffic, runoff	Redirect traffic, restore vegetation
14	3112	Typic ustropept	Landslides, gullies	Active, severe	Foot traffic, runoff	Remove debris, construct retaining wall
15	2111	Xeropsamment	Wind, sand displacement	Active, moderate	Foot traffic	Replenish sand, construct boardwalk
16	2211	Sirdrak	Gully wash	Active, moderate	Runoff, hydrophobicity	Reduce runoff, maintain ground cover
17	2211	Sirdrak	Root exposure	Active, moderate	Road cut, sand displacement	Remove trees, stabilize soil, replant, maintain ground cover
18	2211	Sirdrak	Gullies, root exposure	Active, severe	Road drainage, foot traffic, runoff, hydrophobicity	Redirect traffic, redirect drainage, reduce runoff, repair gullies, maintain ground cover

Erosion Site	Map Unit	Existing Soil Type	Erosion Type	Erosion Rating	Erosion Cause	Recommended Action
19	2211	Sirdrak	Gully, root exposure	Active, moderate	Road drainage, runoff, hydrophobicity	Reduce runoff, repair gully, maintain ground cover
20	2211	Sirdrak	Sand displacement, root exposure	Active, severe	Foot traffic, hydrophobicity	Redirect traffic, remove trees, stabilize soil, replant, maintain ground cover
21	2211	Sirdrak	Sand displacement, root exposure	Active, severe	Foot traffic, hydrophobicity	Redirect traffic, remove trees, stabilize soil, replant, maintain ground cover
22	2211	Sirdrak	Gully, root exposure	Active, severe	Road drainage, runoff, hydrophobicity	reconstruct drainage, reduce runoff, repair gully, maintain ground cover
23	2211	Sirdrak	Sand displacement, gullies, root exposure	Active, severe	Foot traffic, runoff, hydrophobicity	Redirect traffic, remove trees, reduce runoff, stabilize soil, replant, maintain ground cover
24	2211	Sirdrak	Gully	Active, moderate	Foot traffic	Redirect traffic
25	2211	Sirdrak	Sand displacement	Active, severe	Foot traffic	Construct boardwalk, move railing
26	3111	Typic ustropept	Landslides, gullies	Active, severe	Natural cliff face, foot traffic	No action
27	4411	Ustorthent	Landslides, gullies	Active, severe	Natural cliff face, foot traffic	Redirect traffic, no action
28	2211	Sirdrak	Gully, root exposure	Active, moderate	Foot traffic, runoff, hydrophobicity	Redirect traffic, stabilize soil, replant, maintain ground cover
29	2211	Fill	Gully	Active, moderate	Runoff	Redirect drainage, repair gully
30	2211	Sirdrak	Sand displacement, gullies, root exposure	Active, severe	Foot traffic, runoff, hydrophobicity	Redirect traffic, reduce runoff, stabilize soil, replant, maintain ground cover
31	4311	Henneke (variant)	Gully	Active, moderate	Runoff	Redirect drainage, repair gully
32	2211	Fill	Gully	Active, moderate	Runoff	Redirect drainage, repair gully
33	2211	Sirdrak	Gully	Active, severe	Drainage	Redirect drainage, repair gully, add new fill, replant
34	2211	Sirdrak	Gully	Active, severe	Foot traffic	Redirect traffic, stabilize soil, replant

Erosion Site	Map Unit	Existing Soil Type	Erosion Type	Erosion Rating	Erosion Cause	Recommended Action
35	4111/ 4311	Cronkhite/ henneke (variant)	Gully, cut bank	Active, moderate	road drainage	reconstruct drainage
36	4311	Henneke (variant)	Gully	Active, moderate	Foot traffic	Redirect traffic
37	3113	Typic ustropept	Cut bank	Active, minor	Road cut	Stabilize soil, restore vegetation
38	3113	Typic ustropept	Gully	Active, minor	Drainage	Redirect drainage, repair gully
39	3113	Typic ustropept	Cut bank	Active, minor	Road cut	Stabilize soil, replant
40	2211	Sirdrak	Gully	Active, severe	Ground disturbance, road drainage, runoff, hydrophobicity	Redirect drainage, regrade site, repair gully, reduce runoff, replant, maintain ground cover
41	4111	Cronkhite	Gully	Active, severe	Runoff, drainage	Redirect drainage, repair gully, add new fill, pave foot path
42	2222	Fill	Gully	Active, moderate	Runoff	Remove fill, restore riparian
43	4611	Barnabe variant; fill	Gully	Active, moderate	Runoff drainage	Redirect drainage, repair gully, replant
44	2211	Sirdrak	Sand displacement, root exposure	Inactive	Foot traffic	Redirect traffic, remove trees, replant, maintain ground cover
45	2211	Sirdrak, fill	Gully	Active, minor	Foot traffic, runoff, drainage	Redirect drainage, repair gully
46	3113	Typic ustropept	Cut bank	Active, minor	Cut and fill	Stabilize bank, replant
47	2211	Sirdrak	Gully, sand displacement	Active, moderate	Foot traffic, runoff	Redirect traffic, stabilize soil, restore vegetation
48	4211	Barnabe	Gully, root exposure	Active, moderate	Foot traffic, runoff	Redirect foot traffic, repair gully, restore vegetation
49	4111	Cronkhite	Gully; root exposure	Active, moderate	Foot traffic, runoff	Redirect foot traffic, repair gully, restore vegetation
50	3111	Typic ustropept	Gully	Active, moderate	Drainage	Redirect drainage, repair gully
51	4311	Henneke (variant), fill	Gully	Active, minor	Foot traffic, drainage	Redirect traffic, redirect drainage, repair gully, restore vegetation
52	2211	Sirdrak	Sand displacement, root exposure	Active, severe	Foot traffic, runoff, hydrophobicity	Redirect traffic, remove trees, reduce runoff, stabilize soil, restore vegetation

Erosion Site	Map Unit	Existing Soil Type	Erosion Type	Erosion Rating	Erosion Cause	Recommended Action
53	2211	Sirdrak	Sand displacement, gully, root exposure	Active, severe	Foot traffic, runoff, hydrophobicity	Redirect foot traffic, remove trees, reduce runoff, stabilize soil, replant, maintain ground cover

SITES NEAR BAKER BEACH

Another general area of severe erosion on Sirdrak soil lies upslope of Baker Beach, in a bowl-shaped area upslope of the picnic area just below Lincoln Boulevard. Spillover drainage from a poorly constructed road drain on the west side of the road has opened up a sequence of nine gullies around the rim of the bowl (site 18). Foot traffic from a bus stop and housing area across the road has contributed to the development of the gullies. These gullies combine into a larger, root-exposing gully that continues down to the picnic area. Forest trees in the bowl are threatened. The forest is also affected by foot traffic, root exposure, and a hydrophobic soil condition around the picnic area.

Another area affected by drainage and foot traffic is site 22, also above Baker Beach.

East of Baker Beach and north of Battery Chamberlain is a large dune-sand hillside of cypress forest (site 23) that is affected by severe erosion. A graveled spur road branches west off Lincoln Boulevard and terminates on the summit of the dune-sand hill. From the top of the hill, a large amount of foot traffic has moved in all directions downslope to Baker Beach. Sand displacement has resulted in extensive root exposure and tree damage and loss. The mechanical loss of groundcover reduces rainfall infiltration capacity, which, combined with the hydrophobic soil condition, results in substantial runoff that further erodes the sandy soil.

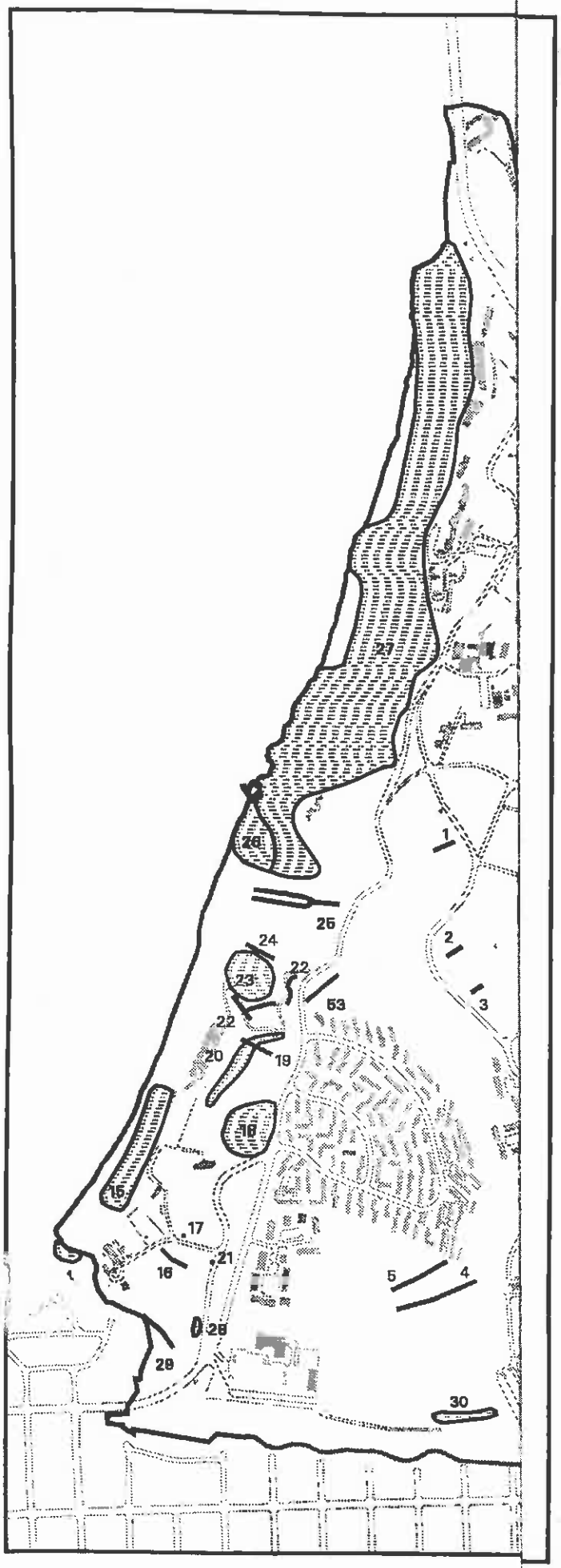
This general condition also characterizes sites 20, 21, and 53 near Baker Beach (site 53 is located in dune scrub); site 30 west and downslope of the Public Health Service Hospital parking lot; and site 52 west of Mountain Lake and Highway 1.

An example of a severe erosion problem in spite of best intentions is seen at the pathway and logway leading down to Baker Beach from near the intersection of Lincoln Boulevard and Battery Crosby Road (site 25). The movement of shifting sand under foot traffic has undermined the rock armoring and pavement of the upper portion of the walkway, causing it to fall away and form a wide, 2-foot-deep gully, adversely affecting the adjoining dune scrub vegetation.

SITES NEAR THE NATIONAL CEMETERY

A combination of road drainage and ground disturbance has opened up a deep, several-hundred-foot-long gully in Sirdrak soil adjacent to the southwestern corner of the National Cemetery (site 40). A drainage outlet from Park Boulevard empties its outflow directly at the top of this gully. Combined with excess runoff from the small watershed of hydrophobic, sandy Sirdrak soil, the water flow from the drainage outlet has cut a wide and deep gully complex and created a large sediment fan at the bottom of the gully.

FIGURE K-1. EXISTING SOIL EROSION SITES



Erosion areas and sites

Gully erosion

Note: Site numbers of erosion sites, erosion areas, and gully erosion refer to Table K-1.

Source: Jones & Stokes Associates field surveys, 1994.

Scale 1" = 1000'

0 500 1000 1500 2000 feet

0 0.2 0.4 0.6 kilometers

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SITES ON MOUNTAIN LAKE AND FORT SCOTT SOILS

Soil types such as the Typic Ustropept and the Cronkhite series may also be adversely affected by foot traffic, soil compaction, and improper drainage, causing severe erosion even where soil is not hydrophobic. An example on Typic Ustropept soil is a eucalyptus grove with severe soil loss, soil compaction, and root exposure on the east bank of Mountain Lake and downslope from a runoff-contributing roadway. An example on Cronkhite series soil is site 41 in the Fort Scott area, a trail that has been marred by gullies as a result of soil compaction and improper drainage.

SITES ALONG THE PACIFIC COASTLINE

Natural erosion may also cause a severe erosion condition, such as at sites 26 and 27 on the coastal bluffs between Baker Beach and the south end of the Golden Gate Bridge. The existing condition of landslides and gullying on the primarily serpentinitic bedrock is natural and may be conducive to some plant species found there. Impromptu foot trails running up and down the bluffs contribute to the severity of the erosion and may further destabilize some vegetated areas.

Another area of natural erosion is a small exposure of Colma Formation soil overlain by dune sand at the mouth of Lobos Creek. Lobos Creek and ocean waves have eroded a small, beautifully patterned bluff in the Colma Formation. In the dune sand above, foot traffic and other ground disturbance have eroded away the bank and a formerly paved area, and these conditions are threatening the integrity of retaining walls protecting homes on the slope above the walls.

Appendix L. Wildlife Inventory

Wildlife Inventory

INTRODUCTION

Background

As a subcontractor to Jones & Jones, Jones & Stokes Associates performed a wildlife inventory to describe the occurrence and seasonal status of birds, mammals, reptiles, amphibians, and rare arthropods at the Presidio of San Francisco for the Golden Gate National Recreation Area (Golden Gate NRA). Jones & Stokes Associates wildlife biologists summarized existing baseline data and performed the studies of reptiles, amphibians, nesting raptors, and other birds described in this document. In addition, Jones & Jones subcontracted with several local experts to conduct focused studies of specific taxonomic groups, including Elizabeth Pierson, Ph.D., and William Rainey, Ph.D. (visual and acoustic surveys of bats); John Hafernik, Ph.D. (rare arthropod surveys); and John Harris, Ph.D. (mammal surveys).

Objectives

The primary objective of conducting this wildlife inventory was to provide Golden Gate NRA staff with a clear understanding of special-status species and general wildlife use of the Presidio forest and natural areas (excluding Crissy Field). A second objective was to develop a method for ranking and managing forest stands at the Presidio according to their relative value to resident and migratory wildlife.

METHODS

Presurvey Investigations

Jones & Stokes Associates wildlife biologists and the subcontractors acquired background data from a diversity of sources to ensure an accurate and comprehensive summary of biological resources of the Presidio. We consulted published literature, museum collections (Museum of Vertebrate Zoology, U.C. Berkeley, and California Academy of Sciences), U.S. Fish and Wildlife Service (USFWS), and California Department of Fish and Game (DFG) status reviews for special-

status species with potential to occur at the Presidio. We also contacted knowledgeable individuals at local universities and conservation organizations for unpublished information on occurrences of specific biological resources at the Presidio.

Jones & Stokes Associates conducted a search of DFG's Natural Diversity Data Base (NDDB) to accumulate information on special-status species and sensitive natural communities known or with potential to be present at the Presidio. We also examined topographic maps, FMP maps, vegetation maps, aerial photographs, Golden Gate NRA file information, Jones & Stokes Associates file information, unpublished inventory reports, and environmental documents prepared for the Presidio previously.

Reconnaissance Surveys

Before initiating intensive surveys, Jones & Stokes Associates biologists and Drs. Hafernik, Harris, Pierson and their assistants conducted reconnaissance-level surveys of the Presidio. We toured the Presidio with Golden Gate NRA staff (Daphne Hatch, biologist, and Laura Nelson, botanist) to ensure that all field personnel were familiar with the distribution of major habitats and the locations of roads, access points, and sensitive resources in the study area. For example, the locations of sensitive coastal dune scrub habitats and rare plant populations were identified so that they could be avoided during the reptile, mammal, and rare arthropod surveys. Multiple reconnaissance surveys were conducted in February, March, or April 1994, depending on when individual research efforts for various types of wildlife were initiated.

Habitat Definitions

A preliminary vegetation map of the Presidio was prepared by Mike Vasey, Ph.D., of San Francisco State University (Vasey pers. comm.), and a map of forest stands was developed by Dr. Joe McBride of U.C. Berkeley (McBride 1984). These maps were modified by Jones & Stokes Associates botanists and each vegetation polygon was classified as a specific plant community type according to Holland's (1986) community classification scheme. The wildlife surveyors used this vegetation map and classification scheme to record field data in native and naturalized habitats (e.g., eucalyptus, Monterey pine, and Monterey cypress) of the Presidio.

Unlike native and naturalized forests that provide extensive wildlife habitat areas, most ornamental species at the Presidio were planted in association with buildings or other developed areas and receive limited use by wildlife. Accordingly, for use in the wildlife data summaries and analyses, ornamental species were grouped into two categories, "palms" and "other ornamentals" (black acacia, acacia verticilata, casuarina, cedar, dracaena, myoporum, New Zealand Christmas tree, pittosporum, poplar, stone pine, sycamore, and weeping willow).

Special-Status Wildlife

A preliminary list of special-status vertebrates and invertebrates with potential to occur at the Presidio was developed based on information gathered during the presurvey investigations and reconnaissance field surveys.

Definitions

Vertebrate and invertebrate species federally listed or proposed for listing as threatened or endangered are protected under the federal Endangered Species Act (ESA) (50 CFR 17.11). In California, state-listed threatened or endangered species are protected under the California ESA (14 CCR 670.5).

In addition to listed and proposed species, special-status species include wildlife and invertebrates in the following categories:

- animal species that are candidates for possible future listing as threatened or endangered under the federal ESA (59 FR 216:58982-59028, November 15, 1994),
- animal species of concern to the USFWS,
- animal species of special concern to DFG (Remsen 1978 [birds] and Williams 1986 [mammals]),
- animals fully protected in California (California Fish and Game Code, Sections 3511 [birds], 4700 [mammals], and 5050 [reptiles and amphibians]), and
- active and recently active raptor nests (California Fish and Game Code, Section 3503.5).

Special-Status Species Inventories

As discussed for specific taxonomic groups below, our field methods followed standardized USFWS and DFG survey procedures for all special-status species. Golden Gate NRA's and Jones & Stokes Associates' preliminary evaluation of existing data sources suggested that management of Presidio forests and natural areas could potentially affect western pond turtles, silvery legless lizards, California red-legged frogs, rare bats, nesting raptors, and western snowy plovers (Natural Diversity Data Base 1994, Hatch pers. comm.). Invertebrates that could be affected by these management activities included mission blue butterflies, San Francisco forktail damselflies, Leech's skyline diving beetles, Ricksecker's water scavenger beetles, globose dune beetles, bumblebee scarab, and tree lupine moths (Hafernik pers. comm.).

Arthropods. Surveys for all rare arthropods were performed by Dr. John Hafernik, a professor of biology at San Francisco State University. He submitted a separate report to Golden Gate NRA (Hafernik 1994) that formed the basis of all discussions of rare arthropods in this report.

Rare arthropod surveys were conducted at the Presidio between March 27 and September 16, 1994. These surveys were designed to provide data on the presence or absence of various special-status arthropods, including the San Francisco forktail damselfly, Leech's skyline diving beetle, Ricksecker's water scavenger beetle, the globose dune beetle, the bumblebee scarab, the tree lupine moth, and the mission blue butterfly. The mission blue butterfly is a federally listed endangered species. The other species listed are species of conern to USFWS. The presence of other arthropods of particular interest or concern was also noted.

Initial habitat surveys were undertaken in September 1993 and March 1994 to identify potential habitat for special-status species, and subsequent sampling efforts focused on those areas. A complete list of sampling locations and dates is provided by Hafernik (1994); however, the general areas surveyed were Baker Beach, the World War II monument area, Inspiration Point, Mountain Lake, Lobos Creek, Crissy Field, and a seep area near the west end of the golf course.

Appropriate sampling methods were chosen for each group of rare arthropods. Aerial and sweep nets were used for most terrestrial sampling; dune beetles were sampled by sifting sand from under vegetation in dune areas. Standard D-frame aquatic nets and small aquarium dip nets were used to sample aquatic habitats.

Species identifications were made using published keys and descriptions as appropriate. Odonates and other aquatic invertebrates were identified using Merritt and Cummins (1984) and Usinger (1956). Dune beetles were identified using Doyen (1976), and mydas flies were identified using Hardy (1950). In addition, museum collections at San Francisco State University and the California Academy of Sciences were used to review geographical ranges and to confirm identifications.

Amphibians and Reptiles. Jones & Stokes Associates conducted surveys for special-status amphibians and reptiles at the Presidio on March 9 and April 17-20, 1994. Based on the preliminary list of special-status species, these surveys focused on California red-legged frogs, western pond turtles, and silvery legless lizards.

California Red-Legged Frogs and Western Pond Turtles. Surveys for California red-legged frogs and western pond turtles primarily involved making observations at Mountain Lake. Visual surveys were conducted while walking along the shoreline and searching for basking individuals with binoculars and a spotting scope. Because walking and viewing were difficult along the densely vegetated shoreline, however, we also anchored two basking logs (5 feet and 15 feet long) approximately 10 feet from the shoreline to increase our opportunities for observing basking turtles.

We conducted dip-net surveys for larval frogs along the lake's perimeter but did not attempt to seine the lake. We also conducted nighttime spotlighting surveys for California red-legged frogs on April 18 and 19, 1994.

Silvery Legless Lizard. We followed the protocol recommended by Fusari and McGinnis (pers. comms.) to conduct silvery legless lizard surveys. This technique included sifting sand by hand or with a rake underneath coastal dune shrubs, including mock heather and bush lupine; we surveyed only areas that had been determined not to have sensitive plant populations.

We used cover boards in sensitive plant communities and rare plant habitats to minimize the disturbance caused by raking or sifting. We placed a total of 20 cover boards at four rare plant locations several weeks before the amphibian and reptile surveys to provide sufficient time to attract invertebrates and legless lizards. The cover boards were 2-foot-square sheets of plywood and were placed underneath shrubs in suitable coastal dune habitats.

Nesting Raptors. Surveys for nesting raptors were conducted on April 18-21 (day-long surveys) and May 13-14, 1994 (half-day surveys). During each survey, two experienced wildlife biologists searched for nesting raptors by walking systematically through all large (i.e., larger than 1.0 acre), forested habitats at the Presidio. We searched tree canopies with binoculars for active nests and looked for evidence of recent nesting (whitewash, feathers, or prey remains); we also noted territorial defense and other nesting behaviors performed by mated pairs.

We consulted Golden Gate NRA records and contacted local raptor experts (e.g., Fish, Hopkins, Murphy, and Stallcup pers. comms.) for information on recent raptor nesting at the Presidio. We returned to these previously discovered nest sites to confirm their current status. All observations of nesting raptors were recorded on topographic maps and additional information was recorded in field notes.

In addition to the Jones & Stokes Associates raptor nesting surveys, Stallcup (pers. comm.) performed four owl surveys in the vicinity of Inspiration Point on June 17, July 9 and 30, and August 1, 1994. These surveys were conducted in the evening or predawn hours and involved walking carefully through most of the forested habitats near Inspiration Point. During these surveys, tapes were played of screech owl vocalizations and searches were made for regurgitated owl pellets and other evidence of owl activity.

Mammals. Based on reviews of existing publications and museum records, Harris (1994) determined that the salt marsh vagrant shrew was the only special-status mammal (excluding bats) that has been recorded at the Presidio. Suitable saltmarsh habitat no longer exists along the Presidio's shoreline, and no searches were made for this subspecies.

Bats. Reconnaissance surveys suggested that overall bat densities at the Presidio were too low to conduct effective netting surveys, the preferred method for species identifications. Instead, Pierson and Rainey (1995) relied primarily on ultrasound monitoring, which permitted some assessment of species diversity and was effective for assessing seasonal patterns and habitat associations. The acoustic surveys take advantage of the fact that foraging bats use high-frequency

sounds to locate their prey. Bat echolocation calls are low-duty-cycle, pulsed signals that are sufficiently characteristic that they can be distinguished analytically from other repetitive environmental sounds, such as insect calls.

Echolocation calls can be monitored using "bat detectors," devices that convert the normally ultrasonic calls of bats into the audible range. Pierson and Rainey's (1995) surveys were conducted using two broad-band detectors (Pettersson D980 or D940); all detectors were connected to analog cassette or DAT recorders, and bat calls were stored for later analysis using SoundEdit Pro for the Macintosh.

Pierson and Rainey (1995) conducted acoustic surveys regularly at four major habitats at the Presidio: forest/forest edge, open area/grassland, riparian areas along Lobos Creek, and open water (from the shores of Mountain Lake). It was evident early in the study that Mountain Lake supported the highest levels of bat activity. Thus, on each sampling night, one investigator was dedicated to this site and monitored bat activity continuously from shortly after sunset until bat activity declined or ceased (1.5-2.0 hours later).

Concurrently, additional investigators sampled other sites, generally for 20 minutes per site. The sites that were sampled repeatedly were El Polin Spring, the forest edge of Hicks Athletic Field, the forest at the corner of Hunter Road and the Central Magazine, the natural grassland reserve west of Wedemeyer Street, the helipad near the Public Health Hospital overlooking the Lobos Creek drainage, Lobos Creek, and the golf course edge at the corner of Arguello Boulevard and West Pacific Avenue. Surveys were conducted on the following dates during 1994: January 14 and 17; March 14; April 28 and 30; May 1, 10, and 29; June 8; July 1 and 3; August 2; September 17 and 18; October 2, 16, and 31; November 30; and December 18. Detailed discussions of the assumptions and techniques for species identifications of acoustic recordings are provided by Pierson and Rainey (1995).

General Wildlife Inventories

Reptiles and Amphibians

During the surveys for special-status amphibians and reptiles, Jones & Stokes Associates wildlife biologists recorded all species they observed. We also turned over logs and searched in leaf litter for secretive species. Similarly, all Jones & Stokes Associates field personnel and subcontractors recorded observations of reptiles and amphibians in their field notes while conducting surveys for other taxa.

Birds

Audubon Surveys. At the request of Golden Gate NRA staff (Hatch pers. comm.), Jones & Stokes Associates wildlife biologists summarized the extensive data compiled by members of the

Golden Gate Audubon Society (Hopkins and Murphy pers. comms.). For this survey, the Presidio was divided into 12 survey areas and birds were counted from January 15 until December 31, 1990. Each visit lasted for 2-3 hours and most surveys ended before 11:00 a.m. Surveying on days with extreme winds or inclement weather was avoided (Hopkins and Murphy pers. comms.).

In each of the 12 survey areas, Audubon Society members conducted twice-monthly surveys by counting all birds detected in eight specific plots, including four that were in "prime" habitat and four that were randomly selected. Plot censuses were performed for 10-minute intervals by counting all birds that could be seen from a single vantage point. In addition to direct counts of individuals, surveyors also noted the habitats where the birds were observed. Unusual bird species seen during nonsurvey periods (e.g., while walking between census points), were noted but individuals were not counted. During the breeding season, evidence of nesting behavior was noted, and in the winter, roosting areas were recorded (Hopkins and Murphy pers. comms.).

Despite the intensity and length of the Audubon Society censuses, these data were not appropriate for detailed statistical analyses. Differences of survey frequency, variable observer experience (especially with bird vocalizations), a lack of quantitative vegetation measurements, and nonstandardized plot sizes (i.e., counting all birds that could be seen from a fixed point rather than counting all birds in a measured area) prohibited detailed comparisons of the bird census data in different locations and habitats on the Presidio (Hopkins pers. comm.). The Audubon Society data do represent a substantial database, however, and they provide important information regarding seasonal trends in abundance (at least in 1990) and bird and habitat associations at the Presidio.

Jones & Stokes Associates biologists summarized the Audubon Society census sheets initially to compile a working list of birds and habitats at the Presidio. Golden Gate NRA personnel requested that the wildlife species list include alphanumeric codes for the following data fields: species code, common name, scientific name, special-status species code (if applicable), breeding status, relative abundance by season, preferred habitats, and primary data sources (Hatch pers. comm.).

During Jones & Stokes Associates' initial screening of the Audubon Society census data, all bird species observed in the survey were recorded in a database. In a second, more intensive data review, each species was assigned a tentative code for relative abundance in each season and its preferred habitats were identified. The draft species list also incorporated data from other unpublished sources, including field notes taken by Jones & Stokes Associates biologists; this list was later reviewed for accuracy by several experienced, local field ornithologists (Fish, Hatch, Hopkins, Murphy, Stallcup pers. comms.).

Nesting Bird Surveys of Lobos Creek. Lobos Creek was not surveyed regularly during the Audubon Society surveys (Hopkins pers. comm.). Therefore, Golden Gate NRA personnel requested that Jones & Stokes Associates wildlife biologists conduct breeding bird surveys in this area (Hatch pers. comm.). Four breeding bird surveys were conducted between 5:30 a.m. and 8:30 a.m. on April 19-21 and May 14, 1994. We attempted to survey the entire riparian corridor during each census and walked from the construction area near the west end of the creek eastward to the

dense willows near the Public Health Hospital. Some areas were inaccessible, however, because of high fences or extremely dense vegetation.

All bird species seen or heard during the survey were identified to species and counted; major bird and habitat associations were also recorded in field notes. A secondary focus of the Lobos Creek bird survey was to monitor the status of nesting red-shouldered hawks that had been located during the raptor surveys a few days before.

Mammals

Surveys for all mammals (excluding bats) were performed by John H. Harris, Ph.D., an associate professor of biology at Mills College. Dr. Harris submitted a separate report to the Golden Gate NRA (Harris 1994) that formed the basis of all mammal discussions in this inventory.

Mammal field surveys involved searching suitable habitats for sightings and sign of mammals, live-trapping for small mammals, and conducting track surveys using smoked aluminum track plates. Baited camera stations were not established because of the frequent human use of the area and a lack of suitable, undisturbed locations. Several days were spent making an overview survey of the entire Presidio to identify suitable habitats for further survey work, gain a general impression of habitat quality and structure, and search for signs of mammals, including feces, burrows, and runways.

Thirteen sites were selected at which to conduct live-trapping for small mammals, including two riparian sites at Lobos Creek; dune scrub, annual grassland, and riparian sites near the Public Health Hospital; and riparian, Monterey pine (two sites), Monterey cypress, and redwood sites near Inspiration Point (Harris 1994). Sherman live-traps were baited with a combination of mixed bird seed, rolled oats, and peanut butter.

Because population density information was not requested by Golden Gate NRA staff, the number and placement of traps was not standardized and traps were placed to fit the size and shape of the area being sampled. In general, traps were placed to take advantage of particularly promising microhabitats, to maximize the opportunities to determine the diversity of mammals in each habitat. Traps were usually hidden to minimize the potential for human disturbance, but were still frequently disturbed, probably by dogs, cats, or raccoons.

Smoked aluminum track plates were placed in the same general areas where live-trapping was conducted. The plates were approximately 2 feet by 3 feet in area, covered with kerosene soot, and baited using canned cat food. Dr. Harris operated eight track plates during the week of June 20-24, five track plates during the week of June 27-July 1, and four track plates during the week of July 5-8, 1994 (Harris 1994).

Wildlife Habitat Value Analysis

Golden Gate NRA staff requested that Jones & Stokes Associates rank forest stands at the Presidio in terms of their relative value to resident and migratory wildlife (Hatch pers. comm.). In response to this request, we developed an overall scheme for ranking individual forest stands as having high, moderate, or low value for wildlife, including special-status species. The primary objective of this analysis was to combine measured or observed criteria for individual forest stands and to map them so that Golden Gate NRA staff could easily identify the relative impacts of proposed forest removal plans and other projects on Presidio wildlife habitats.

Habitat Ranking Variables

Based on the data collected from forests of the Presidio (McBride 1984) and the results of numerous previous studies of wildlife and habitat relationships (e.g., MacArthur and MacArthur 1961, Orians 1975, Pianka 1971, Schoener 1974), we identified eight major factors that influence wildlife use of individual forest stands: forest stand size, tree species diversity, connectivity to other forest stands, forest condition, midstory vegetation (i.e, sapling density), understory vegetation cover, proximity to sources of fresh water (i.e., Mountain Lake or Lobos Creek), and presence of special-status wildlife (Table L-1). Data on forest stand species diversity, condition, sapling densities, and understory vegetation cover were taken from McBride (1984); all other forest variables were measured from Jones & Stokes Associates' geographic information system- (GIS-) based vegetation maps of the Presidio.

Analytical Techniques

Each mapped forest stand was assigned a relative ranking (0 = low, 5 = high) for each of the eight variables. Rank values for the eight variables were summed to provide a total value for each forest stand. Forest stands that were not examined by McBride (1984) were excluded from this analysis.

Relative wildlife values of general forest types were calculated by summing the wildlife species known to occur in each type and dividing these values by the total number of vertebrate species observed in all forest types. Based on these calculations, forest types received the following wildlife habitat index (WHI) rankings in descending order: live oak (0.67), willow (0.66), eucalyptus (0.65), Monterey pine (0.58), Monterey cypress (0.56), redwood (0.52), and ornamental (0.44). Extremely rare and historically observed species were excluded from this analysis.

The relative wildlife values for each forest stand were multiplied by the sums of the variable rankings (i.e., the sum of the scores for all eight variables) for individual forest stands to derive their total wildlife habitat values. The overall wildlife habitat value rankings for all forest stands were plotted onto a histogram for comparison. Based on natural breaks in the histogram (representing approximately one standard deviation from the mean), individual forest stands were subdivided into

Table L-1. Wildlife Habitat Variables and Value Ratings of Presidio Forest Stands

Value Rating	Variables							
	1. Number of Tree Species	2. Polygon Size	3. Polygon Connectivity	4. Forest Condition	5. Forest Midstory	6. Forest Understory	7. Proximity to Creek or Lake	8. Special-Status Species
0	--	<0.1 acre	island (isolated)	<10% live crown	0 saplings per acre	bare	>1,000 ft	absent
1	1	0.1-0.5 acre	island (close <100 ft)	>10-25% crown	>0-25 saplings per acre	woody debris	>500-1,000 ft	--
2	2	>0.5-1.0 acre	1 side	>25-50% live crown	>25-100 saplings per acre	vines (ivy)	>100-500 ft	--
3	3	>1.0-5.0 acres	2 sides	>50-75% live crown	>100-500 saplings per acre	herbs and grasses	>50-100 ft	--
4	4	>5.0-10 acres	3 sides	>75-90% live crown	>500-1,000 saplings per acre	1-25% shrubs	<50 ft	--
5	5	>10 acres	surrounded	>90% live crown	>1,000 saplings per acre	>25% shrubs	adjacent	present

three categories: high (total score greater than 9), moderate (greater than 5 to 9), and low (5 or less). This ranking information was entered into a GIS to produce an overall wildlife habitat value map of the Presidio.

RESULTS

Special-Status Species

Special-status species known to occur at the Presidio are summarized in Table L-2, along with their legal status, habitat requirements, geographical distribution, and source information. Results of recent special-status surveys at the Presidio are described for major taxa below.

Arthropods

Of the taxa targeted in the rare arthropod surveys, only the tree lupine moth was detected at the Presidio (Hafernik 1994). Surveys conducted by DeBenedictis (1988) and Hafernik (1994) indicated that this species is common at Lobos Creek, Mountain Lake, and throughout the Presidio wherever its host plant *(Lupinus arboreus)* is present.

Suitable habitat is generally lacking at the Presidio for all of the remaining rare arthropods that were surveyed by Hafernik (1994). The globose dune beetle and the bumblebee scarab require open sand dune habitats, and most dunes at the Presidio are vegetated. High streamflows and dense emergent vegetation at Lobos Creek and dense vegetation surrounding Mountain Lake apparently make these aquatic habitats unsuitable for the San Francisco forktail damselfly, Leech's skyline diving beetle, and Ricksecker's water scavenger beetle.

Only one of the three known host plants for the mission blue butterfly *(Lupinus varicolor)* is known to occur on coastal bluffs of the Presidio near the Golden Gate Bridge. Surveys of this area did not detect evidence of eggs, larvae, or larval feeding damage of mission blue butterflies, and it is unlikely that the Presidio was ever part of the historical range of this species (Hafernik 1994).

Although it has no special legal status, the mydas fly is potentially rarer and more threatened than the federally listed mission blue butterfly, and the Presidio is the only place where the species has been observed recently (Hafernik 1994). This species was described from a single male specimen that is housed at the California Academy of Sciences; females of this species have not been described previously (Hardy 1950). Hafernik (1994) collected several copulating pairs of this species from sand dune areas above Baker Beach and near the east end of Lobos Creek. These records add considerably to the information available for this little-known species and may provide an opportunity for describing the females (Hafernik 1994). Additional study of the distribution and life history of this species is required to accurately assess its current population status (Hafernik pers. comm.).

Table L-2. Status, Habitat, and Distribution of Special-Status Wildlife at the Presidio, San Francisco

Species	Status[a] Federal/State	Habitat	Distribution	Occurrence at the Presidio[b]
Invertebrates				
San Francisco forktail-damselfly *Ischnura gemina*	SC/--	Occurs in small, shallow ponds, marshes, and human-made channels with sparse emergent vegetation	Endemic to San Francisco Bay Area; extant populations in Marin County, south to Santa Cruz County	Potential habitat at Mountain Lake and Lobos Creek, but not detected in recent surveys (16)
Bumblebee scarab *Lichnanthe ursina*	SC/--	Open coastal sand dunes	Sonoma County south to San Mateo County, as well as inland Los Angeles County	No recent records; most specimens collected in San Francisco early in this century (16)
Globose dune beetle *Coelus globosus*	SC/--	Coastal strand communities with shrubs or herbaceous plants growing in sand	Sporadically distributed from central and southern California into Baja California; from Bodega Bay, Sonoma County, south to Ensenada, Baja California	Potential habitat at Baker Beach and Crissy Field, but not detected in recent surveys (16)
Tree lupine moth *Grapholita edwardsiana*	SC/–	Coastal sand dunes and nearby locations, usually in association with its larval food plant *Lupinus arboreus*	San Francisco Bay Area	Common throughout the Presidio, including Lobos Creek and Mountain Lake (16)
Amphibians				
California red-legged frog *Rana aurora draytoni*	FT/SSC	Associated with coldwater pools with emergent and submergent vegetation and riparian species along the edges	Found along the coast and coastal mountain ranges of California, from Humboldt County to San Diego County, and in the Sierra Nevada from Butte County to Fresno County	Historical records only; not detected in recent surveys of Lobos Creek and Mountain Lake (11)
Reptiles				
Southwestern pond turtle *Clemmys marmorata pallida*	SC/SSC	Requires aquatic habitats, such as ponds, marshes, or streams, with rocky or muddy bottoms and vegetation, for cover and food	Occurs along the central coast of California east to the Sierra Nevada, and along the southern California coast inland to the Mojave and Colorado Deserts; the range overlaps with that of the northwestern pond turtle throughout the Delta and in the Central Valley from Sacramento County to Tulare County	Historical records from Mountain Lake, but not detected there in recent surveys (11)
Black legless lizard *Aniella pulchra nigra*	SC/SSC	Moist, warm habitats with loose soil for burrowing and low-lying plant cover; beaches, chaparral, pine-oak woodland, or riparian areas	California coast in Monterey and northern San Luis Obispo County	Outside the known range of this subspecies; one historical record probably represents an introduced individual (10)

Species	Status[a] Federal/State	Habitat	Distribution	Occurrence at the Presidio[b]
Birds				
Common loon *Gavia immer*	–/SSC	Nearshore coastal waters and bays; less common at large inland bodies of deep water with productive fisheries	Primarily a winter visitor to California, but an occasional year-round resident; found along the entire coast and large inland bodies of water	Uncommon nonbreeding visitor to nearshore areas (1, 3, 8)
American white pelican *Pelecanus erythrorhynchos*	–/SSC	Uses freshwater lakes with islands for breeding; inhabits river sloughs, freshwater marshes, salt ponds, and coastal bays during the rest of the year	The largest nesting colony is at Great Salt Lake; winters along the California coast from southern Sonoma County south to San Diego County, the Salton Sea and Mexico, inland from the San Francisco Bay through the Delta region, and areas in Kings, Kern, Riverside, and Imperial Counties; summers and breeds in Plumas, Modoc, and Siskiyou Counties	Rare fall and winter visitor to the bay (2, 3, 6, 9)
Brown pelican *Pelecanus occidentalis*	FE/SE	Typically in littoral ocean zones, just outside the surf line; nests on offshore islands	Present along the entire coastline, but does not breed north of Monterey County	Regular visitor to nearshore areas, especially on the ocean side (1, 7)
Double-crested cormorant *Phalacrocorax auritus*	–/SSC	Uses rocky coastlines, beaches, inland ponds, and lakes; needs open water for foraging, and nests in riparian forests or on protected islands	Winters along the entire California coast and inland over the Coast Range into the Central Valley from Tehama County to Fresno County; a permanent resident along the coast from Monterey County to San Diego County, along the Colorado River, Imperial, Riverside, Kern, and King Counties, and the islands off San Francisco; summers in Siskiyou, Modoc, Lassen, Shasta, Plumas, and Mono Counties; also breeds in the San Francisco Bay Area and in Yolo and Sacramento Counties	Common nonbreeding resident; occurs at Mountain Lake and on offshore rocks and islands (1, 2, 3)
Harlequin duck *Histrionicus histrionicus*	SC/SSC	Found in turbulent mountain streams in summer and rough coastal waters in winter; forages by diving along rocky shorelines	Could nest in Calaveras County and eastern Amador and Placer Counties; winters on the coast from Del Norte County to central San Luis Obispo County	Rare winter visitor to rocky, nearshore waters (8)

Species	Status[a] Federal/State	Habitat	Distribution	Occurrence at the Presidio[b]
Osprey *Pandion haliaetus*	--/SSC	Nests in snags or cliffs near the ocean, large lakes, or rivers with abundant fish populations	Nests along the north coast from Marin County to Del Norte County, east through the Klamath and Cascade Ranges, and the northern end of the Sacramento Valley; important breeding population at Lake Almanor in Plumas County, and small numbers elsewhere in Plumas, Butte, Yuba, Tuolumne, and Madera Counties; also nests at Lake Tahoe, Mono Lake in Mono County, Tinnemaha Lake in Inyo County, and Lake Isabella in Kern County; winters along the coast from San Mateo County to San Diego County	Uncommon, nonbreeding resident; forages over nearshore coastal waters (1, 3)
White-tailed kite *Elanus caeruleus*	--/CP	Low foothills or valley areas with valley or live oaks, riparian areas, and marshlands near open grasslands for foraging	Lowland areas west of Sierra Nevada from head of Sacramento Valley south, including coastal valleys and foothills to western San Diego County at the Mexico border	Rare spring and uncommon fall migrant over the Marin Headlands, and probably the Presidio (9)
Bald eagle *Haliaeetus leucocephalus*	FE/SE	In western North America, nests and roosts in coniferous forests within 1 mile of a lake, a reservoir, a river, or the ocean	Nests in Siskiyou, Modoc, Trinity, Shasta, Lassen, Plumas, Butte, Tehama, Lake, and Mendocino Counties and in the Lake Tahoe Basin; winter range includes the rest of California except the southeastern deserts, very high altitudes in the Sierra Nevada and east of the Sierra Nevada, south of Mono County	Rare fall migrant over the Marin Headlands and probably the Presidio (8, 9)
Northern harrier *Circus cyaneus*	--/SSC	Uses marshes, meadows, and seasonal and agricultural wetlands	Found as either a permanent or winter resident over all of California except in the Klamath, Cascade, and Sierra Nevada Ranges	Uncommon spring and fall migrant over the Marin Headlands and probably the Presidio (1, 8, 9)
Sharp-shinned hawk *Accipiter striatus*	--/SSC	Uses dense-canopy ponderosa pine or mixed conifer forest and riparian habitats	Found as permanent resident in the Sierra Nevada, Cascade, Klamath, and north Coast Range at midelevations, as well as along the coast in Marin, San Francisco, San Mateo, Santa Cruz, and Monterey Counties; winters over the rest of the state except very high elevations	Uncommon spring migrant and winter visitor to forested areas; common fall migrant (1, 6, 8, 9)

Species	Status[a] Federal/State	Habitat	Distribution	Occurrence at the Presidio[b]
Cooper's hawk *Accipiter cooperi*	--/SSC	Nests primarily in riparian forests dominated by deciduous species; also nests in densely canopied forests from digger pine-oak woodland up to ponderosa pine; forages in open woodlands	Found in all parts of California except high altitudes in the Sierra Nevada; winters in the Central Valley, southeastern desert regions, and plains east of the Cascade Range; permanent residents occupy the rest of the state	Uncommon or rare nonbreeding visitor to forested areas at all seasons (1, 6, 8, 9)
Northern goshawk *Accipiter gentilis*	SC/SSC	Nests in red fir, Jeffrey pine, and lodgepole pine forests	Permanent resident on the Klamath and Cascade Ranges, the north Coast Range from Del Norte County to Mendocino County, and the Sierra Nevada south to Kern County; winters in Modoc, Lassen, Mono, and northern Inyo Counties; rare in southern California	Extremely rare fall migrant over the Marin Headlands and probably the Presidio (9)
Swainson's hawk *Buteo swainsoni*	--/ST	Nests in oaks and cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain fields	Uses the lower Sacramento and San Joaquin Valleys, the Klamath Basin, and Butte Valley; California's largest nesting concentration exists in Yolo County	Rare spring and fall migrant over the Marin Headlands and probably the Presidio (9)
Ferruginous hawk *Buteo regalis*	SC/SSC	Found in open terrain in plains and foothills where ground squirrels and other prey are available	Only winters in California; can be seen along the coast from Sonoma County to San Diego County, eastward to the Sierra Nevada foothills and southeastern deserts, the Inyo-White Mountains, the plains east of the Cascade Range, and Siskiyou County	Rare spring and fall migrant over the Marin Headlands and probably the Presidio (6, 8, 9)
Golden eagle *Aquila chrysaetos*	--/SC	Nests on cliffs, escarpments, and large oaks; forages over annual grasslands	Found as permanent resident over most of California; uses only high-altitude areas in the Sierra Nevada in summer and the Central Valley in winter	Rare or uncommon spring and fall migrant over the Marin Headlands and probably the Presidio (3, 8, 9)
Merlin *Falco columbarius*	--/SC	Open woodland, especially when dominated by blue, live, or valley oaks	The entire state, but most observations west of the Sierra Nevada; rare visitor to offshore islands	Uncommon nonbreeding visitor to open forests (1, 2, 3, 8, 9)
American peregrine falcon *Falco peregrinus anatum*	FE/SE	Nests and roosts on protected ledges of high cliffs, usually adjacent to lakes, rivers, or marshes that support large populations of birds	Found as permanent resident on the north and south Coast Range; summers on the Cascade and Klamath Ranges, in the Sierra Nevada, and south through the Transverse and Peninsular Ranges and the plains east of the Cascade Range	Uncommon nonbreeding resident; a pair breeds on the lower deck of the Bay Bridge and forages throughout San Francisco, including the Presidio (1, 2, 8)

Species	Status[a] Federal/State	Habitat	Distribution	Occurrence at the Presidio[b]
Prairie falcon *Falco mexicanus*	--/SSC	Nests on cliffs or escarpments adjacent to dry, open terrain, uplands, marshes, or seasonal agricultural wetlands	Found as permanent resident on the south Coast, Transverse, Peninsular, and northern Cascade Ranges; the southeastern deserts; Inyo-White Mountains; Modoc, Lassen, and Plumas Counties; and the foothills surrounding the Central Valley; winters in the Central Valley, along the coast from Santa Barbara County to San Diego County; and in Marin, Sonoma, Humboldt, Del Norte, and Inyo Counties	Rare spring and fall migrant over the Marin Headlands and the Presidio (6, 9)
Western snowy plover *Charadrius alexandrinus nivosus*	FT/SSC	Found on coastal beaches above the normal high tide limit	Winters along the coast from Del Norte County to San Diego County, with some areas supporting permanent populations; nests at inland lakes throughout northwestern, central, and southern California	Uncommon winter visitor to sandy coastal areas (7, 8)
Long-billed curlew *Numenius americanus*	--/SSC	Nests at high-elevation grasslands adjacent to lakes or marshes in migration and winter; frequents coastal beaches and mudflats or interior grasslands or agricultural fields	Nests in northeastern California in Modoc, Siskiyou, and Lassen Counties; winters along coast or in interior valleys west of Sierra Nevada	Uncommon winter visitor to sandy beaches and mudflats (1, 2, 8)
California gull *Larus californicus*	--/SSC	Forages in a variety of habitats, including beaches, mudflats, freshwater and alkali marshes, rivers, lakes, and urban areas; nests colonially on islands isolated from mainland predators	Winters along the Pacific coast from British Columbia to Mexico; in the interior of California, it frequents the Sacramento River Delta and Central Valley, the plains east of the Cascade Range, northern Plumas County and southwestern Mono County, the Lake Tahoe Basin, the Transverse and Peninsular Ranges, and the Salton Sea; nests at Great Basin lakes and at south San Francisco Bay; largest California breeding colony is at Mono Lake	Common nonbreeding visitor in spring, fall, and winter; occurs along shorelines and at Mountain Lake (1, 2, 3, 8)
Elegant tern *Sterna elegans*	SC/SSC	Sandy, coastal areas and adjacent waters, both outside the surf line and in sheltered bays	Coastal visitor from the Mexico border north to San Francisco Bay	Uncommon nonbreeding visitor in summer and fall; forages over nearshore coastal waters (1, 2, 3)
California least tern *Sterna antillarum browni*	FE/SE	Nests on sandy, upper ocean beaches and occasionally uses mudflats; forages on adjacent surf line, estuaries, or the open ocean	Nests on beaches along the San Francisco Bay and along the southern California coast from southern San Luis Obispo County south to San Diego County	Rare, nonbreeding fall visitor, recently observed at the Coast Guard pier and nests across the bay at the Alameda Naval Air Station (3, 8)

Species	Status[a] Federal/State	Habitat	Distribution	Occurrence at the Presidio[b]
Marbled murrelet *Brachyramphus marmoratus*	FT/SE	Nesting in conifer stands greater than 150 years old and may be found up to 35 miles inland; winters on the open ocean well offshore	Nesting sites from the Oregon border to Eureka and between Santa Cruz and Half Moon Bay; may be found in Monterey Bay in winter	Uncommon winter visitor to offshore, oceanic waters (3)
Vaux's swift *Chaetura vauxi*	--/SSC	Nests in hollow, burned-out tree trunks in large conifers; most other activities are conducted in the air	Coastal belt from Del Norte County south to Santa Cruz County; also nests rarely in midelevation forests of the Sierra Nevada	Uncommon spring and fall migrant over the Presidio (2)
Willow flycatcher *Empidonax traillii*	–/SE	Uses riparian areas and large, wet meadows with abundant willows for breeding; usually occurs in riparian habitats during migration	Summer range includes a narrow strip along the eastern Sierra Nevada from Shasta County to Kern County, another strip along the western Sierra Nevada from El Dorado County to Madera County, and a small population in San Diego County; widespread in migration	Uncommon spring and fall migrant, especially at Lobos Creek and Mountain Lake (8)
Loggerhead shrike *Lanius ludovicianus*	SC/SSC	Prefers open habitats with scattered shrubs, trees, posts, fences, utility lines, or other perches	Resident and winter visitor in lowlands and foothills throughout California; rare on coastal slope north to Mendocino County, occurring only in winter	Rare winter visitor (1, 3, 8)
California yellow warbler *Dendroica petechia* [illegible]	/SSC	Nests in riparian areas dominated by willows, cottonwoods, sycamores, or alders, or in mature chaparral; may also use oaks, conifers, and urban areas near streamcourses	Nests over all of California except the Central Valley, the Mojave Desert region, and high altitudes in the Sierra Nevada; winters along the Colorado River and in parts of Imperial and Riverside Counties; two small permanent populations are in San Diego and Santa Barbara Counties	Uncommon spring migrant, common fall migrant, and rare winter visitor; does not breed at the Presidio (1, 2, 3)
Saltmarsh common yellowthroat *Geothlypis trichas sinuosa*	SC/SSC	Prefers freshwater marshes in summer and saltwater or brackish water in fall and winter, requires tall grasses, tules, and willow thickets for nesting and cover	Found only in the San Francisco Bay Area in Marin, Napa, Sonoma, Solano, San Francisco, San Mateo, Santa Clara, and Alameda Counties	Uncommon resident and possible breeder at Mountain Lake; (1, 3) subspecific identity of Presidio population is unknown
Mammals				
Salt marsh vagrant shrew *Sorex vagrans halicoetes*	SC/SSC	Uses midelevation salt marsh habitats with dense growths of pickleweed; requires driftwood and other objects for nesting cover	Occurs in the southern portion of the San Francisco Bay	A single specimen of this subspecies was collected at the Presidio in 1940 (California Academy of Sciences specimen #8153); no specific location or habitat information is available but this specimen may have been collected at former marshlands between Ft. Point and Crissy Field (14)

Species	Status[a] Federal/State	Habitat	Distribution	Occurrence at the Presidio[b]
Yuma myotis *Myotis yumanensis*	--/SSC	Roosts colonially in a variety of natural and human-made sites, including caves, mines, buildings, bridges, and trees; in northern California, maternity colonies are usually in fire-scarred redwoods, pines, or oaks; forages for insects over open water	Considered common and widespread in northern California; colonies known from Marin and San Francisco Counties	Call sequences attributed to this species have been detected sporadically at the Presidio; both Mountain Lake and Lobos Creek appear to offer suitable foraging habitat; unlikely to breed at the Presidio (16)

[a] Status explanations:

Federal

FE = listed as endangered under the federal Endangered Species Act.

FT = listed as threatened under the federal Endangered Species Act.

PE = proposed for federal listing as endangered under the federal Endangered Species Act.

SC = species of concern to USFWS. Includes many species that were formerly categorized as Category 2.

-- = no legal status.

State

SE = listed as endangered under the California Endangered Species Act.
ST = listed as threatened under the California Endangered Species Act.
SSC = species of special concern.
CP = California fully protected species.
-- = no legal status.

[b] Data sources:

1 = Golden Gate Audubon Society, year-long bird censuses at the Presidio (February 1990-February 1991), organized by Dan Murphy and Alan Hopkins.

2 = Alan Hopkins, personal communications with Jones & Stokes Associates (September 1993 to present) and comments on the draft checklist June 1994.

3 = Mary Louise Rosegay, an annotated list of birds found on the Presidio of San Francisco (1966-March 1988).

4 = Sidney England and Mark Sogge, 1988, field notes compiled for the U.S. Army Corps of Engineers, Environmental Impact Statement for the Presidio Master Plan.

5 = A. Kurz, checklist of San Francisco's inland native wildlife–trees and invertebrates, 1983.

6 = Rich Stallcup, observations made at the Presidio and comments on draft checklist April 1994.

7 = Jones & Stokes Associates, field notes compiled during 1994.

8 = Dan Murphy, comments on Presidio Draft General Management Plan and Environmental Impact Statement, December 20, 1993, comment on draft checklist June 1994, and historical records from *The Gull*.

9 = Allen Fish, Golden Gate Raptor Observatory, observations of Presidio overflights from the Marin Headlands, and comments on draft checklist June 1994.

10 - Benjamin Banta and David Morafka, 1966, an annotated checklist of the recent amphibians and reptiles inhabiting the City and County of San Francisco, California.

11 = Ed Ely, observations made during 1993 amphibian and reptile surveys in Lobos Creek at the Presidio and field observations spanning more than 30 years in San Francisco County.

12 = Specimens in the collections of the California Academy of Sciences.

13 = Specimens in the collections of the Museum of Vertebrate Zoology, University of California, Berkeley.

14 = John Hafferni, field notes compiled during 1994 and summary report submitted to GGNRA.

15 = Recent observations made by National Park Service personnel.

16 = John Haffernik, field notes compiled during 1994 and summary report submitted to GGNRA.

17 = Elizabeth Pierson, Field notes compiled during 1994 and summary report submitted to GGNRA.

Amphibians and Reptiles

No special-status amphibian or reptile species were detected at the Presidio during the Jones & Stokes Associates field surveys. As discussed below, populations of California red-legged frogs, western pond turtles, and legless lizards have already been extirpated from the Presidio.

California Red-Legged Frog. California red-legged frogs historically occurred at Mountain Lake (Natural Diversity Data Base 1994, Banta and Morafka 1966). In spring 1993, Ely conducted daytime and nighttime surveys for this species at Lobos Creek. He did not observe red-legged frogs there, but suitable habitat existed along the creek; he also concluded that this species could be present at Mountain Lake. (Ely pers. comm.) However, Jones & Stokes Associates' 1994 survey did not reveal any larval or adult California red-legged frogs in Mountain Lake. Perhaps the presence of bullfrogs at this lake is one reason why California red-legged frogs no longer reside there.

Southwestern Pond Turtle. Southwestern pond turtles occurred historically in several lakes in San Francisco County, including Mountain Lake (Natural Diversity Data Base 1994, Banta and Morafka 1966). Banta and Morafka (1966) speculated that pond turtles in Mountain Lake were introduced based on the lack of breeding activity, young, or eggs they observed there. Ely (pers. comm.) did not find any southwestern pond turtles in 1993, and Jones & Stokes Associates did not observe these turtles during twice-daily visits in 1994. Perhaps the large number of introduced red-eared sliders at this lake is one reason why southwestern pond turtles no longer occur there.

Silvery Legless Lizard. Only one black legless lizard locality is known in San Francisco County, and the species was observed there before 1900 (Banta and Morafka 1966, Bury 1985). Banta and Morafka (1966) indicated that this record was possibly an error or based on an introduced individual. A related subspecies, the silvery legless lizard, is actually more likely to occur on the San Francisco peninsula; the black legless lizard is the typical form on the Monterey Peninsula (Stebbins 1985), and its taxonomic status is currently under review by USFWS (Zeiner et al. 1990).

Bury (1985) concurred with Banta and Morafka (1966) regarding the need for more data to validate the single black legless lizard record because early zoologists often used the nearest large city to describe the localities of the specimens they collected. Bury (1985) did not detect this species during December 1984 surveys at Baker Beach, but he found suitable habitat, including mock heather, beach burr, bush lupine, buckwheat, and sand verbena, at this location. He concluded that an intensive search is needed in the fragmented remaining dune habitats to determine if legless lizards are present and to confirm the historical locality.

No legless lizards were observed during the Jones & Stokes Associates field surveys, although the coastal dune shrub provides suitable habitat for this species. The soils were moist, and the abundance of invertebrates underneath many of the cover boards should have been attractive to this species.

Birds

As indicated in Table L-2, 29 special-status bird taxa (i.e., species and subspecies) have been observed at the Presidio. Most of these species, however, appear as rare or uncommon migrants or seasonal visitors, and none have been confirmed as breeding at the Presidio. Because of the irregular occurrence of most special-status birds, Jones & Stokes Associates and its subcontractors did not perform focused surveys for any of these species. Instead, the data used to compile Table L-2 were gathered during the presurvey investigations, while summarizing the Audubon Society bird survey data, and through consultations with experienced local ornithologists (Fish, Hopkins, Murphy, Stallcup pers. comms.).

Migratory Raptors and Swifts. Almost half of the documented special-status birds have only been sighted as rare or uncommon migrants flying over the Presidio (Table L-2). These species include the bald eagle and peregrine falcon (federally listed and state-listed as endangered), as well as federal candidates and state species of concern such as northern harriers, golden eagles, and merlins. Other special-status raptors, such as white-tailed kites, northern goshawks, Swainson's hawks, ferruginous hawks, and prairie falcons have been observed from the Marin Headlands flying in the direction of the Presidio, the closest open space area after crossing over the Golden Gate (Fish pers. comm.). Few, if any, observations have actually been made of these species at the Presidio, however. Similar to the migratory raptors, Vaux's swifts are uncommon spring and fall visitors and are always seen flying overhead.

Sharp-shinned hawks and Cooper's hawks are frequent migrants and winter visitors to the Presidio, but neither species breeds there. These hawks forage throughout the mosaic of grasslands, shrublands, and forests of the Presidio. All forest types are used, but broken forests with adjacent grasslands or riparian habitats are preferred. Both species were observed on several occasions during the Jones & Stokes Associates field surveys in May and June 1994.

Nesting Raptors. Two red-shouldered hawk nests were active in 1994 at the Presidio, one near the Golden Gate Bridge (forest stand E9) and one on a hillside north of Lobos Creek (forest stand CP170). Both nests were in tall eucalyptus trees. An active red-tailed hawk nest is also present in a tall Monterey pine near El Polin Spring (forest stand P138). The exact locations of these nesting sites will be disclosed to Golden Gate NRA under separate cover to reduce the potential for human disturbance of these sensitive nests.

In addition to finding three active nest sites, Jones & Stokes Associates observed territorial behavior by pairs of red-shouldered hawks near Mountain Lake (forest stand E201), near the reservoir (forest stand E222), and near the Officer Family Housing near Arguello Boulevard (forest stand R109). Territorial red-tailed hawks were observed at the west side of the golf course (forest stand C184). These observations may represent additional nesting pairs. Surveyors saw a Cooper's hawk land in a tall Monterey cypress near Inspiration Point (forest stand C184) and begin calling. This bird was not observed in subsequent visits to this site, however, and probably did not nest at the Presidio.

American kestrels are also known to breed at the Presidio, and nesting pairs have been observed in palms near Letterman Hospital; snags and buildings are other possible nest sites (Fish and Hatch pers. comms.). No nests of this species, however, were specifically identified in spring 1994 surveys of Presidio forests.

In 1994, Stallcup (pers. comm.) located a pair of western screech owls near Inspiration Point. One bird was calling from a small redwood grove (forest stand R136), and the other was downslope in the direction of El Polin Spring. Because the coastal race of this species is almost entirely resident, these screech owls may be a mated pair (Stallcup pers. comm.). In addition to detections near Inspiration Point, western screech owls have also been detected at Arguello Gate and at Lobos Creek; the Presidio may be the only site where this species is still resident in San Francisco.

Although red-shouldered hawks, red-tailed hawks, American kestrels, and western screech owls are not listed as threatened or endangered by USFWS or DFG, active and inactive nests of these species and all other raptors are protected under California Fish and Game Code Section 3503.5. This code recognizes the relative scarcity of raptor nests and their sensitivity to disturbance.

Ocean and Shoreline Birds. Many of the Presidio's special-status birds are largely confined to the ocean or bay (Table L-2). Common loons, brown pelicans, harlequin ducks, and marbled murrelets are rare or uncommon visitors to the Presidio coastline; American white pelicans have been noted flying over San Francisco Bay from the Presidio on a few occasions. Ospreys, western snowy plovers, long-billed curlews, elegant terns, and California least terns are uncommon or rare along the coastal shoreline and nearshore waters of the Presidio. Double-crested cormorants are common nonbreeding residents of the bay and ocean shorelines, and they also frequent Mountain Lake.

Passerines. Only four special-status passerines have been recorded at the Presidio: loggerhead shrikes, willow flycatchers, yellow warblers, and, possibly, saltmarsh yellowthroats (Table L-2). Loggerhead shrikes are rare winter visitors to grassland and scrub habitats and have only been observed on a few occasions.

Willow flycatchers and yellow warblers are migratory visitors to willow riparian habitats along Lobos Creek and at Mountain Lake. Neither species nests at the Presidio because of the limited extent of suitable nesting habitat and the presence of brown-headed cowbirds. Both willow flycatchers and yellow warblers have been extirpated as nesting species in the lowlands of California due to nest parasitism by brown-headed cowbirds (Remsen 1978, Harris et al. 1987, Sanders and Flett 1989).

Common yellowthroats are uncommon visitors to Mountain Lake, where they have been recorded in all seasons. They are suspected of nesting in emergent vegetation surrounding the lake because of their year-round presence there; however, no definite evidence of nesting has been found. The saltmarsh yellowthroat is the most likely subspecies of common yellowthroat to be found on the San Francisco peninsula (Grinnell and Miller 1944); however, the subspecific status of yellowthroats at Mountain Lake has apparently not been determined.

Mammals

Harris (1994) reported that the salt-marsh vagrant shrew was the only special-status mammal (excluding bats) that has been recorded at the Presidio (Appendix I). This subspecies of the vagrant shrew is restricted to saltmarsh habitats in the southern and central San Francisco Bay region. It is a federal species of concern and a California species of special concern (Williams 1986).

A single specimen of this shrew from the Presidio is in the collection of the California Academy of Sciences (no. 8153). The specimen was collected in 1940, and no specific location or habitat information is available. It seems likely that this shrew may have lived in saltmarsh habitat located between Fort Point and Crissy Field. No suitable habitat for this shrew is currently found on the Presidio; thus, there is no reason to believe that it currently occurs there. However, a related and more widespread subspecies, the vagrant shrew, is an uncommon resident of the Presidio (Harris 1994).

Bats. Yuma myotis was the only special-status bat species detected during surveys conducted at the Presidio (Pierson and Rainey 1995). This species is one of the most widespread and relatively common bats in northern California; it has been recorded at numerous sites in north coastal counties, and colonies are known from the Marin Headlands, Marin County, and the San Francisco Zoological Park (Pierson and Rainey 1995). This species is somewhat tolerant of human disturbance and is one of the few species of bats that persists in relatively developed areas.

Other special-status bats that could potentially occur at the Presidio based on their geographical ranges are long-eared myotis, fringed myotis, long-legged myotis, Townsend's big-eared bat, and mastiff bat; all of these species are Category 2 candidates for federal listing as either threatened or endangered. Habitat conditions or available insect prey (or both), however, do not appear suitable for any of these species, and their occurrence at the Presidio is unlikely (Pierson and Rainey 1995).

General Wildlife Occurrence

All vertebrate species with documented occurrence at the Presidio are listed in Table L-3, along with alphanumeric codes describing legal status (if applicable), seasonal (birds only) or year-round (amphibians, reptiles, and mammals) occurrence, habitat associations, and data sources. Throughout its history, a total of 262 vertebrate species have been recorded at the Presidio, including 225 birds, eight amphibians, 15 reptiles, and 14 mammals.

Amphibians and Reptiles

Overall, the diversity of amphibians and reptiles at the Presidio is low (Table L-3). For example, during 10 person-days of amphibian and reptile surveys, Jones & Stokes Associates observed only three native species in coastal dune scrub and eucalyptus woodland habitats of the

Table L-3. Wildlife of the Presidio of San Francisco

Species Code	Common Name	Scientific Name	Legal Status	Seasonal Abundance[b,c]				Habitat Association[d]							Data Sources[e]
			Federal/State[a]	S	S	F	W	Water	Shoreline	Grassland	Scrub	Forest	Developed	Aerial	
	BIRDS[a]														
RTLO	Red-throated loon	*Gavia stellata*		U		U	C	oc, ba							1, 2, 3, 8
PALO	Pacific loon	*Gavia pacifica*		U		U	C	oc, ba							1, 2, 3, 8
COLO	Common loon	*Gavia immer*	--/SSC	U		U	U	oc, ba							1, 3, 8
YBLO	Yellow-billed loon	*Gavia adamsii*					X	oc							2, 3
PBGR	Pied-billed grebe	*Podilymbus podiceps*		U	U	U	U	pd, ma							1, 2, 7, 8,
HOGR	Horned grebe	*Podiceps auritus*		R		R	U	oc, ba							1, 2, 8
RNGR	Red-necked grebe	*Podiceps grisegena*					R	oc							2, 3
EAGR	Eared grebe	*Podiceps nigricollis*		U		U	U	oc, ba, pd							3, 8
WEGR	Western grebe	*Aechmophorus occidentalis*		C	U	A	A	oc, ba							1, 3
CLGR	Clark's grebe	*Aechmophorus clarkii*		U	R	U	C	oc, ba							1, 2, 3, 6, 8
NOFU	Northern fulmar	*Fulmarus glacialis*					U I	oc							3
SOSH	Sooty shearwater	*Puffinus griseus*			U I	U I		oc							3
AWPE	American white pelican	*Pelecanus erythrorhynchos*	--/SSC			R	R	ba						✦	2, 3, 6, 9
BRPE	Brown pelican--	*Pelecanus occidentalis*	FE/SE	U	C	C	U	ba, oc, pd						✦	1
DCCO	Double-crested cormorant	*Phalacrocorax auritus*	--/SSC	C	C	C	C	ba,oc, pd	tr					✦	1, 2, 3
BRAC	Brandt's cormorant	*Phalacrocorax penicillatus*		C	C	C	C	oc, ba	tr					✦	1, 3
PECO	Pelagic cormorant	*Phalacrocorax pelagicus*		U	U	U	U	oc, ba	tr					✦	1, 2, 3
MAFR	Magnificent frigatebird	*Fregata magnificens*			X			oc						✦	2, 3, 8
GTBH	Great blue heron	*Ardea herodias*		U	U	U	U	pd, ma						✦	1, 3
GREG	Great egret	*Casmerodius albus*				U	R	ma						✦	1, 3, 6
GRHE	Green heron	*Butorides striatus*		R				pd							6
SNEG	Snowy egret	*Egretta thula*					R		us						6
BCNH	Black-crowned night-heron	*Nycticorax nycticorax*		U	U	U	U	pd				wi			1, 3
TUSW	Tundra swan	*Cygnus columbianus*					X	ba							2, 3
SNGO	Snow goose	*Chen caerulescens*					R	ba							3
GWTE	Green-winged teal	*Anas crecca*		U		U	U	pd, ba							2

Species Code	Common Name	Scientific Name	Legal Status	Seasonal Abundance[b,c]				Habitat Association[d]							Data Sources[c]
			Federal/State[a]	S	S	F	W	Water	Shoreline	Grassland	Scrub	Forest	Developed	Aerial	
MALL	Mallard*	*Anas platyrhynchos*		A	A	U	A	pd, st, ba, ma	ts					✦	1, 2, 6, 7, 8
NOPI	Northern pintail	*Anas acuta*		R		R	R	pd							2
NOSH	Northern shoveler	*Anas clypeata*		U		U	U	ba, pd							2
GADW	Gadwall	*Anas strepera*		U		U	U	pd							2
AMWI	American wigeon	*Anas americana*		U		U	C	ba, pd	ts						2, 3
CANV	Canvasback	*Aythya valisineria*		U		U	U	ba, pd							2, 3, 8
RNDU	Ring-necked duck	*Aythya collaris*		U		U	U	pd							2
GRSC	Greater scaup	*Aythya marila*		U		U	C	ba, oc							1, 2, 3
LESC	Lesser scaup	*Aythya affinis*		U		U	C	ba, oc							1, 2, 3
HADU	Harlequin duck	*Histrionicus histrionicus*	SC/SSC				R	oc	tr						8
OLDS	Oldsquaw	*Clangula hyemalis*					R	oc							3
BLSC	Black scoter	*Melanitta nigra*		U			U	ba, oc							2, 8
SUSC	Surf scoter	*Melanitta perspicillata*		C	R	C	A	ba, oc							1, 3, 6
WWSC	White-winged scoter	*Melanitta fusca*		U		U	U	ba, oc							1, 3
COGO	Common goldeneye	*Bucephala clangula*		U		U	C	ba, oc							2, 3
BUFF	Bufflehead	*Bucephala albeola*		U		U	C	ba, oc							2, 3
RBME	Red-breasted merganser	*Mergus serrator*		U		U	U	ba, oc							1, 2, 3, 8
RUDU	Ruddy duck	*Oxyura jamaicensis*		U		U	C	ba, oc, pd							1, 3
TUVU	Turkey vulture	*Cathartes aura*		U	U	C	U					eu, mc, mp		✦	1
OSPR	Osprey	*Pandion haliaetus*	--/SSC	U	U	U	U	oc						✦	1, 3
WTKI	White-tailed kite	*Elanus caeruleus*	CP	R		U								✦	9
BAEA	Bald eagle	*Haliaectus leucocephalus*	FE/SE			R								✦	8, 9
NOHA	Northern harrier	*Circus cyaneus*	--/SSC	U		C		ma		ag				✦	1, 8, 9
SSHA	Sharp-shinned hawk	*Accipiter striatus*	--/SSC	U		C	U			ag		all		✦	1, 6, 8 9
COHA	Cooper's hawk	*Accipiter cooperii*	--/SSC	U	R	U	U			ag		all		✦	1, 6, 8, 9
NOGO	Northern goshawk	*Acipiter gentilis*	SC/SSC			X								✦	9

Species Code	Common Name	Scientific Name	Legal Status	Seasonal Abundance[b,c]				Habitat Association[d]							Data Sources[e]
			Federal/State[a]	S	S	F	W	Water	Shoreline	Grassland	Scrub	Forest	Developed	Aerial	
RSHA	Red-shouldered hawk*	*Buteo lineatus*		C	C	C	C					all		✦	1, 3, 7, 8
BWHA	Broad-winged hawk	*Buteo platypterus*				U	R							✦	6, 9
SWHA	Swainson's hawk	*Buteo swainsonii*	--/ST	R		R								✦	6, 8, 9
RTHA	Red-tailed hawk*	*Buteo jamaicensis*		C	C	C	C			ag		all		✦	1, 3, 7
FEHA	Ferruginous hawk	*Buteo regalis*	SC/SSC	R		R								✦	8, 9
RLHA	Rough-legged hawk	*Buteo lagopus*		R		RI								✦	6, 9
GOEA	Golden eagle	*Aquila chrysaetos*	--/SSC	R		U								✦	3, 8, 9
AMKE	American kestrel*	*Falco sparverius*		C	U	C	C					sn		✦	1, 3, 7
MERL	Merlin	*Falco columbarius*	--/SSC	U		U	U							✦	1, 2, 3, 8, 9
PEFA	Peregrine falcon	*Falco peregrinus*	FE/SE	U	U	U	U							✦	1, 2, 8
PRFA	Prairie falcon	*Falco mexicanus*	--/SSC	R		R								✦	6, 9
CAQU	California quail*	*Callipepla californica*		C	C	C	C			ag, sg	ds, cs	all	la, or		1, 2, 7
SORA	Sora	*Porzana carolina*		U	R	U	U	ma							1, 2
COMO	Common moorhen	*Gallinula chloropus*					X	pd							2
AMCO	American coot*	*Fulica americana*		C	C	C	C	ba, pd, ma	ts						1, 3
BBPL	Black-bellied plover	*Pluvialis squatarola*		U		U	C		ts, tr						1, 2, 3
PGPL	Pacific golden plover	*Pluvialis fulva*					R		ts						3
SNPL	Snowy plover	*Charadrius alexandrinus*	FT/SSC				U		ts						7, 8
SEPL	Semipalmated plover	*Charadrius semipalmatus*		U		U			ts						1, 2
KILL	Killdeer*	*Charadrius vociferus*		U	U	U	C	pd	ts, us				la, ro	✦	1, 2, 3, 6
BLOY	Black oystercatcher	*Haematopus bachmani*		U	U	U	U		tr						1, 2
GRYE	Greater yellowlegs	*Tringa melanoleuca*		R		R		pd	ts						2
WILL	Willet	*Catoptrophorus semipalmatus*		C		A	C		ts, tr						1, 2
WATA	Wandering tattler	*Heteroscelus incanus*		U		U	U		tr						1, 2, 3
WHIM	Whimbrel	*Numenius phaeopus*		R		R			ts						1, 2, 6
LBCU	Long-billed curlew	*Numenius americanus*	--/SSC				U		ts						1, 2, 8
MAGO	Marbled godwit	*Limosa fedoa*		U		U	C		ts						1, 2

Species Code	Common Name	Scientific Name	Legal Status	Seasonal Abundance[b,c]				Habitat Association[d]							Data Sources[e]
			Federal/State[a]	S	S	F	W	Water	Shoreline	Grassland	Scrub	Forest	Developed	Aerial	
RUTU	Ruddy turnstone	*Arenaria interpres*		U		U	U		tr						1
BLTU	Black turnstone	*Arenaria melanocephala*		C		C	C		tr						1, 6
SURF	Surfbird	*Aphriza virgata*		C		C	C		tr						1, 6, 8
SAND	Sanderling	*Calidris alba*		U		U	C		ts, tr						1
WESA	Western sandpiper	*Calidris mauri*		R	R	R			ts						1, 2
LESA	Least sandpiper	*Calidris minutilla*		R	R	R			ts						1, 2, 3
DUNL	Dunlin	*Calidris alpina*		R	R	R			ts						1, 2
SBDO	Short-billed dowitcher	*Limnodromus griseus*		R		R			ts						2
LBDO	Long-billed dowitcher	*Limnodromus scolopaceus*		R		R			ts						2
COSN	Common snipe	*Gallinago gallinago*					U	ma					la		2
RNPH	Red-necked phalarope	*Phalaropus lobatus*		R		R		oc	ts, tr						2
POJA	Pomarine jaeger	*Stercorarius pomarinus*				R			oc					✦	2
PAJA	Parasitic jaeger	*Stercorarius parasiticus*			RI	UI	R		oc, ba					✦	2, 3, 6
BOGU	Bonaparte's gull	*Larus philadelphia*		U		U	U	oc	ts, tr, pi					✦	1
HMGU	Heermann's gull	*Larus heermanni*		U	C	C	C	oc, ba	ts, tr, pi					✦	1, 2, 3
MEGU	Mew gull	*Larus canus*		C		C	A	oc, ba, pd	ts, tr, pi					✦	1, 2, 3
RBGU	Ring-billed gull	*Larus delawarensis*		C	R	C	C	oc, ba	ts, tr, pi				la	✦	1, 2, 3
CAGU	California gull	*Larus californicus*	--/SSC	C		C	C	oc, ba, pd	ts, tr, pi				la	✦	1, 2, 3, 8
HEGU	Herring gull	*Larus argentatus*		U		U	U	oc, ba	ts, tr, pi				la	✦	1, 2, 3
THGU	Thayer's gull	*Larus thayeri*		R		R	U	oc, ba	ts, tr, pi				la	✦	2, 8
WEGU	Western gull+	*Larus occidentalis*		A	C	A	A	oc, ba, pd	ts, tr, pi				la	✦	1, 2, 6
GWGU	Glaucous-winged gull	*Larus glaucescens*		U		U	C	oc, ba, pd	ts, tr, pi				la	✦	1, 3
GLGU	Glaucous gull	*Larus hyperboreus*					X	oc, ba	ts, tr, pi					✦	2, 3
CATE	Caspian tern	*Sterna caspia*		U	U	U		oc, ba	ts, pi					✦	2
ELTE	Elegant tern	*Sterna elegans*	SC/SSC		U	U		oc, ba	ts, pi					✦	1, 2, 3
COTE	Common tern	*Sterna hirundo*			R	R		oc, ba						✦	1, 2
FOTE	Forster's tern	*Sterna forsteri*		U	U	C	U	oc, ba	ts, pi					✦	1, 2

Table L-3. Continued

Species Code	Common Name	Scientific Name	Legal Status	Seasonal Abundance[b,c]				Habitat Association[d]							Data Sources[e]
			Federal/State[a]	S	S	F	W	Water	Shoreline	Grassland	Scrub	Forest	Developed	Aerial	
LETE	Least tern	*Sterna antillarum*	FE/SE		R	H		oc	ts, tr, pi					✦	3, 8
COMU	Common murre	*Uria aalge*		U	U	C	U	oc, ba							1, 6
PIGU	Pigeon guillemot	*Cepphus columba*		U	U	U	R	oc, ba	tr						1, 2, 3, 6
MAMU	Marbled murrelet	*Brachyramphus marmoratus*	FT/SE				U	oc							3
RODO	Rock dove*	*Columba livia*	#	C	C	C	C					cu	bu, la, ro	✦	1
BTPI	Band-tailed pigeon*	*Columba fasciata*		U I	U I	U I	U I					all	or	✦	1, 2
MODO	Mourning dove*	*Zenaida macroura*		A	A	A	A			ag	cs	all	la, or, ro	✦	1, 2, 3
BAOW	Barn owl ?	*Tyto alba*		R	R	R	R					eu	bu		7, 8
WESO	Western screech-owl*	*Otus kennicottii*		U	U	U	U					oa			2, 3, 6, 8
GHOW	Great horned owl*	*Bubo virginianus*		U	U	U	U					all		✦	1, 2
COPO	Common poorwill	*Phalaenoptilus nuttallii*				H									8
VASW	Vaux's swift	*Chaetura vauxi*	--/SSC	U		U								✦	2
WTSW	White-throated swift	*Aeronautes saxatalis*		U		U								✦	2, 9
ANHU	Anna's hummingbird*	*Calypte anna*		C	C	C	C				cs	all		✦	1, 3
RUHU	Rufous hummingbird	*Selasphorus rufus*		R		R						eu, mp, mc	or	✦	1, 2
ALHU	Allen's hummingbird*	*Selasphorus sasin*		C	C	C					ds	eu, mp, mc	or	✦	1, 3
BEKI	Belted kingfisher	*Ceryle alcyon*		U	U	U	U	pd, st, ba						✦	1, 3
ACWO	Acorn woodpecker	*Melanerpes formicivorus*		R I		R I						oa, sn	te	✦	1, 2, 3
RBSA	Red-breasted sapsucker	*Sphyrapicus ruber*		U		U	U					all	or	✦	1, 3
NUWO	Nuttall's woodpecker	*Picoides nuttallii*				R						oa, sn			1, 2, 3, 7
DOWO	Downy woodpecker*	*Picoides pubescens*		C	C	C	C					wi, oa, eu, sn			1, 2, 3
HAWO	Hairy woodpecker?	*Picoides villosus*		R	R	R	R					all			1, 2, 3, 8
NOFL	Northern flicker*	*Colaptes auratus*		U	U	U	C			ag		all	la, te, pa, or	✦	1, 3, 8
OSFL	Olive-sided flycatcher*	*Contopus borealis*		U	U	U						all	te		1, 3, 8
WWPE	Western wood-pewee+	*Contopus sordidulus*		U		U						all			1, 3, 6, 7

Species Code	Common Name	Scientific Name	Legal Status	Seasonal Abundance[b,c]				Habitat Association[d]							Data Sources[e]
			Federal/State[a]	S	S	F	W	Water	Shoreline	Grassland	Scrub	Forest	Developed	Aerial	
PSFL	Pacific-slope flycatcher ?	*Empidonax difficilis*		U	U	C						wi, oa			1
WIFL	Willow flycatcher	*Empidonax traillii*	--/SE	U		U						wi			8
HAFL	Hammond's flycatcher	*Empidonax hammondii*		U		U						mp, mc, mx, re			2, 3
DUFL	Dusky flycatcher	*Empidonax oberholseri*		U		U						oa, mp, mc, mx			2, 3
BLPH	Black phoebe*	*Sayornis nigricans*		C	C	C	C	st, sp, pd				wi	or, bu, te		1, 3
SAPH	Say's phoebe	*Sayornis saya*		U		U				ag					1, 3
ATFL	Ash-throated flycatcher	*Mylarchus cinerascens*		U		U						oa, eu	or		1
WEKI	Western kingbird	*Tyrannus verticalis*		U		U				ag	cs, ds	oa	la	✦	1, 3
HOLA	Horned lark	*Eremophila alpestris*		H									la		8
TRSW	Tree swallow*	*Tachycineta bicolor*		C	C	C	R					sn, eu, mp, re		✦	1, 2, 3, 6
VGSW	Violet-green swallow +	*Tachycineta thalassina*		C	U	C						sn		✦	1, 3
NRWS	Northern rough-winged swallow	*Stelgidopteryx serripennis*		U	U	U								✦	2, 3
CLSW	Cliff swallow*	*Hirundo pyrrhonota*		U	U	U							bu	✦	1, 2, 3, 6
BASW	Barn swallow*	*Hirundo rustica*		C	C	U							bu	✦	1, 2, 3, 7
STJA	Steller's jay	*Cyanocitta stelleri*		R	R	R	R					mx, mp, mc, re		✦	1, 2, 3, 6
SCJA	Scrub jay*	*Aphelocoma coerulescens*		C	C	C	C					eu, wi, oa	all	✦	1
CLNU	Clark's nutcracker	*Nucifraga columbiana*				X	X							✦	3, 8
AMCR	American crow ?	*Corvus brachyrhynchos*		C	C	C	C					all	la	✦	1, 3
CORA	Common raven*	*Corvus corax*		C	C	C	C		tr, ur			all		✦	1, 3
CBCH	Chestnut-backed chickadee*	*Parus rufescens*		A	A	A	A					all	or		1
BUSH	Bushtit*	*Psaltriparus minimus*		C	C	C	C					all	or		1, 3
RBNU	Red-breasted nuthatch	*Sitta canadensis*				C I	U I					mp, mc, mx, re			1, 8
WBNU	White-breasted nuthatch	*Sitta carolinensis*					R					oa			2

Table L-3. Continued

Species Code	Common Name	Scientific Name	Legal Status	Seasonal Abundance[b,c]				Habitat Association[d]							Data Sources[c]
			Federal/State[a]	S	S	F	W	Water	Shoreline	Grassland	Scrub	Forest	Developed	Aerial	
PYNU	Pygmy nuthatch*	*Sitta pygmaea*		A	A	A	A					all			1, 2, 3
BRCR	Brown creeper*	*Certhia americana*		C	C	C	C					mc, mp, mx,re	pa		1, 3
BEWR	Bewick's wren +	*Thryomanes bewickii*		U	U	U	U				cs, ds	oa, wi	or		1, 2, 3, 8
WIWR	Winter wren +	*Troglodytes troglodytes*		U	U	U	C					bl,wi, to, iv			1, 3
HOWR	House wren	*Troglodytes aedon*		U		U	R					wi,oa, eu	or		1, 7
MAWR	Marsh wren	*Cistothorus palustris*		U		U	R	ma				wi			1, 3
GCKI	Golden-crowned kinglet+	*Regulus satrapa*		U		U	C I					eu, mp, mc, mx, re	or		1, 3, 6, 7
RCKI	Ruby-crowned kinglet	*Regulus calendula*		C		C	A				cs, ds	all	or		1, 3
BGGN	Blue-gray gnatcatcher	*Polioptila caerulea*		U		U	R				cs, ds	wi, oa	or		2, 4, 9
WEBL	Western bluebird	*Sialia mexicana*		H											8
SWTH	Swainson's thrush ?	*Catharus ustulatus*		U	U	U						wi, mc, re,bl,to			1
HETH	Hermit thrush	*Catharus guttatus*		U		U	C			ag		all	or		1, 4
TOSO	Townsend's solitaire	*Myadestes townsendi*					X							✦	2
AMRO	American robin*	*Turdus migratorius*		A	A	A	A			ag		all	la, or		1, 4
VATH	Varied thrush	*Ixoreus naevius*		U		U	U I			ag		all			1, 2
WREN	Wrentit*	*Chamaea fasciata*		U	U	U	U				cs, ds				3, 6, 7, 8
NOMO	Northern mockingbird*	*Mimus polyglottos*		C	C	C	C					oa,wi, eu	or	✦	1, 3
CEWA	Cedar waxwing	*Bombycilla cedrorum*		C I		C I	A I					eu, oa	or		1
LOSH	Loggerhead shrike	*Lanius ludovicianus*	SC/SSC				R			ag, sg	cs, ds				1, 3, 8
EUST	European starling*	*Sturnus vulgaris*	#	A	A	A	A			ag	cs, ds	all	all	✦	1
SOVI	Solitary vireo	*Vireo solitarius*		U		U						oa, wi			1, 3
HUVI	Hutton's vireo*	*Vireo huttoni*		U	U	U	U					all			1, 2, 3, 8
WAVI	Warbling vireo	*Vireo gilvus*		U		C						oa, mx, wi,mp	or		1

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			Federal/State[a]	S	S	F	W	Water	Shoreline	Grassland	Scrub	Forest	Developed	Aerial	
TEWA	Tennessee warbler	*Vermivora peregrina*		X	X	X		sp							1, 2, 3, 6
OCWA	Orange-crowned warbler*	*Vermivora celata*		C	C	C	U				ds, cs	all	or		1, 7
NAWA	Nashville warbler	*Vermivora ruficapilla*		U		U	R					oa,wi, eu	or		1, 2, 6
NOPA	Northern parula	*Parula americana*				X						wi			2
YEWA	Yellow warbler	*Dendroica petechia*	--/SSC	U		C	R					all	or		1, 2, 3
MAWA	Magnolia warbler	*Dendrosca magnolia*				X						mx			2
YRWA	Yellow-rumped warbler	*Dendroica coronata*		A		A	A			ag	cs, ds	all	or, pa, la		1, 5, 7
BGWA	Black-throated gray warbler	*Dendroica nigrescens*		U		U	R					oa,eu, wi			1, 2, 3
TOWA	Townsend's warbler	*Dendroica townsendi*		C		C	C					all	or		1, 4
HEWA	Hermit warbler	*Dendroica occidentalis*		U	U	U	R					mc, mp, mx,re			2, 3, 6
PAWA	Palm warbler	*Dendroica palmarum*				R	X		us			mx, oa			2, 6
BPWA	Blackpoll warbler	*Dendroica striata*				X						mx			2, 3
BAWW	Black-and-white warbler	*Mniotilta varia*				X	X					wi, mx			3, 6
MGWA	MacGillivray's warbler	*Oporornis tolmiei*		U		U		st				wi			2, 5
COYE	Common yellowthroat ?	*Geothlypis trichas*	SC/SSC	U	U	U	U	ma, st				wi			1, 3
WIWA	Wilson's warbler +	*Wilsonia pusilla*		C	U	C					cs	all	or		1, 8
WETA	Western tanager	*Piranga ludoviciana*		U		C						all	or		1
BHGR	Black-headed grosbeak+	*Pheucticus melanocephalus*		U		U						all	or		1, 3, 6
LABU	Lazuli bunting	*Passerina amoena*		U		U						oa, wi			1, 3
RSTO	Rufous-sided towhee*	*Pipilo erythrophthalmus*		U	U	U	U				cs	oa, wi, eu,bl,to			1, 6, 7
CATO	California towhee*	*Pipilo fuscus*		C	C	C	C				cs, ds	oa, wi, eu,bl,to	la		1, 6, 7
CHSP	Chipping sparrow	*Spizella passerina*		U	H	U				ag	cs, ds	oa			3, 8
LASP	Lark sparrow	*Chondestes grammacus*				R				ag		oa	la		1, 3

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			Federal/State[a]	S	S	F	W	Water	Shoreline	Grassland	Scrub	Forest	Developed	Aerial	
FOSP	Fox sparrow	*Passerella iliaca*		U		U	C				cs	bl,wi, iv, to	or		1, 3
SOSP	Song sparrow*	*Melospiza melodia*		C	C	C	C	st, sp, ma			cs	bl, wi	or		1
LISP	Lincoln's sparrow	*Melospiza lincolnii*		U		U	U			ag		bl, wi			1, 8
SWSP	Swamp sparrow	*Melospiza georgiana*					R	ma				bl, wi			1
WTSP	White-throated sparrow	*Zonotrichia albicollis*		R		R	U			ag	cs, ds	bl, wi, to	or, la		1
GCSP	Golden-crowned sparrow	*Zonotrichia atricapilla*		C		C	A			ag	cs, ds	all	or, la		1
WCSP	White-crowned sparrow*	*Zonotrichia leucophrys*		A	A	A	A			ag	cs, ds	all	or, la		1
DEJU	Dark-eyed junco*	*Junco hyemalis*		C	C	A	A			ag	cs, ds	all	or, la		1
BOBO	Bobolink	*Dolichonyx oryzivorus*				X								✦	3
RWBL	Red-winged blackbird*	*Agelaius phoeniceus*		C	C	C	C	ma, st		ag		wi		✦	1, 6, 8
WEME	Western meadowlark	*Sturnella neglecta*		U	R	U	U			ag			la		1
BRBL	Brewer's blackbird*	*Euphagus cyanocephalus*		A	A	A	A		us	ag		all	all	✦	1
BHCO	Brown-headed cowbird*	*Molothrus ater*		U	U	U	U			ag		wi	or, la, te	✦	1
HOOR	Hooded oriole*	*Icterus cucullatus*		U	U							eu	pa		1, 2, 3
NOOR	Northern oriole	*Icterus galbula*		U		U						oa,eu, wi	or	✦	1
PUFI	Purple finch*	*Carpodacus purpureus*		U	U	U	U I					mp, mc, mx, re	la, or		1, 3
HOFI	House finch*	*Carpodacus mexicanus*		A	A	A	A			ag	cs, ds	all	all	✦	1
RECR	Red crossbill*	*Loxia curvirostra*		U I	U I	U I	U I					mp, mc, mx		✦	1, 2, 6
PISI	Pine siskin*	*Carduelis pinus*		C	C	A	A I					all	or	✦	1, 6
LEGO	Lesser goldfinch*	*Carduelis psaltria*		U	U	U	R				cs, ds	oa,eu, wi	or, la	✦	1, 6
AMGO	American goldfinch*	*Carduelis tristis*		C	C	U	R				cs, ds	oa,eu, wi	or, la	✦	1, 6
LAGO	Lawrence's goldfinch	*Carduelis lawrencei*		H											8
EVGR	Evening grosbeak	*Coccothraustes vespertinus*				R						mp, mx		✦	3
HOSP	House sparrow *	*Passer domesticus*	#	C	C	C	C						all		1
	MAMMALS														

Species Code	Common Name	Scientific Name	Legal Status	Seasonal Abundance[b,c]				Habitat Association[d]							Data Sources[e]
			Federal/State[a]	S	S	F	W	Water	Shoreline	Grassland	Scrub	Forest	Developed	Aerial	
	Big brown bat	*Eptesicus fuscus*			U	U	U	pd				all		✦	16
	Red bat	*Lasiurus blossevilli*		R								all		✦	'12, 13, 16
	Hoary bat	*Lasiurus cinereus*		U		U	U	pd		all		all	gc	✦	12, 16
	California myotis	*Myotis californicus*			U	U	U	pd				all		✦	13, 16
	Yuma myotis	*Myotis yumanensis*	--/SSC		U	U	U	pd				all		✦	12, 13, 16
	Mexican free-tail	*Tadarida brasiliensis*		C	U	C	C	pd		all		all	gc	✦	12, 13, 16
	Vagrant shrew	*Sorex vagrans vagrans*		U							ag	all with ag, bl			12
	Salt marsh vagrant shrew	*Sorex vagrans halicoetes*	SC/SSC	H				ma							12, 14
	Ornate shrew	*Sorex ornatus*		C						ag		all with ag, bl			12, 14
	Broad-footed mole	*Scapanus latimanus*		C						ag		all with ag, la			13
	California ground squirrel	*Spermophilus beecheyi*		H						ag					12
	Fox squirrel	*Sciurus niger*	#	R								mc, mp, mx			15
	Valley pocket gopher	*Thomomys bottae*		A						ag, sg	cs, ds	all	la		13, 14
	Western harvest mouse	*Reithrodontomys megalotis*		A						ag	cd, ds	all with ag, bl			14
	Deer mouse	*Peromyscus maniculatus*		U							cs, ds	all with ag, bl			12
	California vole	*Microtus californicus*		A						ag, sg	cs, ds	all with ag, bl			14
	Roof rat	*Rattus rattus*	#	U								bl	bu		14
	Striped skunk	*Mephitis mephitis*		C						ag	cs, ds	all with ag, bl	bu, la		14
	Raccoon	*Procyon lotor*		A					ur, tr	ag	cs, ds	all with ag, bl	bu, la		14
	Cat	*Felis domesticus*	#	A						ag, sg	cs, ds	all with ag, bl	bu, la		14

Species Code	Common Name	Scientific Name	Legal Status	Seasonal Abundance[b,c]				Habitat Association[d]							Data Sources[e]
			Federal/State[a]	S	S	F	W	Water	Shoreline	Grassland	Scrub	Forest	Developed	Aerial	
	Black-tailed deer	*Odocoileus hemionus*		H						ag, sg		all with ag, bl	la		5
	AMPHIBIANS														
	Coast range newt	*Taricha torosa torosa*		R				pd, st		ag		all			10
	Arboreal salamander	*Aneides lugubris*		U						ag	cs	all			5, 11
	California slender salamander	*Batrachoseps attenuatus*		A						ag, sg	cs	all			5, 7, 10, 11
	Yellow-eyed salamander	*Ensatina eschscholtzi xanthoptica*		U								all			10
	California toad	*Bufo boreas halophilus*		U				pd, st, sp, ma							5, 10
	Pacific chorus frog	*Pseudacris regilla*		U				pd, st, sp, ma							10, 11
	California red-legged frog	*Rana aurora draytonii*	FT/SSC	H				pd, st, sp, ma							11
	Bullfrog	*Rana catesbeiana*	#	U				pd, st							7, 10
	REPTILES														
	Southwestern pond t[illegible]	*Clemmys marmorata pallida*	SC/SSC	H				pd, st		ag					11
	Red-eared pond slider	*Chrysemys scripta*	#	A				pd							7
	San Francisco alligator lizard	*Gerrhonotus coerleus coeruleus*		C						ag, sg	cs, ds	all	all		5, 10, 11
	California alligator lizard	*Gerrhonotus multicarinatus ùimulticarinatusù*		U						ag, sg	cs, ds	all	all		10
	Western skink	*Eumeces skiltonianus skiltonianus*		R						ag, sg		all			5, 10
	Northwestern fence lizard	*Sceloporus occidentalis occidentalis*		U						ag, sg	cs		all		11
	Pacific rubber boa	*Charina bottae bottae*		X						ag, sg	cs	all			10
	Western yellow-bellied racer	*Coluber constrictor mormon*		X						ag, sg					10, 11
	Sharp-tailed snake	*Contia tenuis*		R				st		ag		all			5, 10
	Pacific ringneck snake	*Diadophis punctatus amabilis*		R						ag		all			10

Species Code	Common Name	Scientific Name	Legal Status	Seasonal Abundance[b,c]				Habitat Association[d]							Data Sources[e]
			Federal/State[a]	S	S	F	W	Water	Shoreline	Grassland	Scrub	Forest	Developed	Aerial	
	California kingsnake	*Lampropeltis getulus californiae*		X						ag, sg					10, 11
	Pacific gopher snake	*Pituophis melanoceucus catenifer*		X						ag, sg					10, 11
	Santa Cruz garter snake	*Thamnophis couchi atratus*		R				pd, st, sp, ma							10, 11
	Coast garter snake	*Thamnophis elegans terrestris*		U				pd, st, sp, ma		ag, sg	cs, ds	all			10, 11
	Northern Pacific rattlesnake	*Crotalus viridus oreganus*		X						ag, sg					5, 10, 11

Notes:

[a] Legal Status Categories

Federal

FE = listed as endangered under the federal Endangered Species Act.
FT = listed as threatened under the federal Endangered Species Act.
PE = proposed for federal listing as endangered under the federal Endangered Species Act.
SC = species of concern; species for which existing information indicates it may warrant listing but for which substantial biological information to support a proposed rule is lacking.
-- = No status definition.

State

SE = listed as endangered under the California Endangered Species Act.
ST = listed as threatened under the California Endangered Species Act.
SP = fully protected under the California Fish and Game Code.
SSC = species of special concern in California.
-- = No status definition.

Non-Native Species

= introduced species in California; not protected under the Migratory Bird Treaty Act.

[b] Seasonal Abundances - seasons follow calendar dates.

[c] Abundance Categories

A	=	Abundant; many individuals always present.
C	=	common; usually present, sometimes many individuals.
U	=	uncommon; one or a few individuals sometimes present.
R	=	rare; often highly localized or markedly seasonal, not present every year.
I	=	irruptive; irregular occurrence, not present every year but can occur in large numbers.
E	=	extremely rare; outside the species; typical range, represented by one or a few records.
H	=	historical; observed historically, but no documented records for at least 50 years.
X	=	extralimital (occurrence outside of normal range).

[d] Habitat Associations

Water

oc = ocean	st = stream	is = tidal sand	tr = tidal rock
ba = bay	sp = spring	us = upland sand	ur = upland rock
pd = pond	ma = marsh	pi = piers or pilings	

Grassland

ag = annual grassland	cs = costal scrub	SG = serpentine grassland	ds = dune scrub

Forest

eu = eucalyptus	mc = Monterey cypress	mp = Monterey pine	mx = mixed pine/cypress
re = redwood	oa = live oak	wi = willow	sn = snags
bl = blackberry (understory)	iv - English ivy (understory)	to = toyon (understory)	

Developed/Residential

la = lawns	pa = palms	or = other ornamentals*	bu = buildings
ro = roads	gc = golf course	te = telephone poles and wires	

Aerial

✦ = observed flying over a variety of habitats.

* = Ornamentals incl. le black acacia, acacia verticillata, casuarina, cedar, dracaena, myoporum, New Zealand Christmas tree, pittosporum, poplar, stone pine, sycamore, and weeping willow.

Data Sources

1 = Golden Gate Audubon Society, year-long bird censuses at the Presidio (February 1990 - February 1991), organized by Dan Murphy and Alan Hopkins.
2 = Alan Hopkins, personal communications with Jones & Stokes Associates (September 1993 to present) and comments on the draft checklist June 1994.
3 = Mary Louise Rosegay, an annotated list of birds found on the Presidio of San Francisco (1966 through March 1988).
4 = Sidney England and Mark Sogge, 1988, field notes compiled for the U.S. Army Corps of Engineers, Environmental Impact Statement for the Presidio Master Plan.
5 = A. Kurz, checklist of San Francisco's inland native wildlife--trees and invertebrates, 1983.
6 = Rich Stallcup, observations made at the Presidio, and comments on draft checklist April 1994.
7 = Jones & Stokes Associates, field notes compiled during 1994.
8 = Dan Murphy, comments on Presidio Draft General Management Plan and Environmental Impact Statement, December 20, 1993, comments on draft checklist June 1994, and historical records from The Gull.
9 = Allen Fish, Golden Gate Raptor Observatory, observations of Presidio overflights from the Marin Headlands, and comments on draft checklist June 1994.
10 = Benjamin Banta and David Morafka, an annotated checklist of the recent amphibians and reptiles inhabiting the city and county of San Francisco, California.
11 = Ed Ely, observations made during 1993 amphibian and reptile surveys, in Lobos Creek at the Presidio and field observations spanning more than 30 years in San Francisco County.
12 = Specimen in the collections of the California Academy of Sciences.
13 = Specimen in the collections of the Museum of Vertebrate Zoology, University of California, Berkeley.
14 = John Harris, field notes compiled during 1994.
15 = Recent observations made by National Park Service personnel.
16 = Elizabeth Pierson and William Rainey, field notes compiled during 1994 and summary report submitted to Golden Gate NRA.

Breeding Categories. Codes for bird breeding categories are given after the common name:

* = Confirmed nester at the Presidio, including observations of nests with eggs or young, adults carrying food or fecal sacs.
\+ = Suspected nester at the Presidio, including observations of sing males in the same areas, pairs holding territories, or active courtship displays.
? = Nesting status at the Presidio unknown.

Presidio: California slender salamanders (30), western fence lizards (two), and alligator lizards (two). We also noted two introduced species, including more than 20 red-eared sliders and several adult bullfrogs at Mountain Lake. Harris (pers. comm.) observed a coast garter snake near Lobos Creek during his mammal surveys.

Two special-status species, California red-legged frogs and western pond turtles, have been extirpated from the Presidio (Table L-3). Compared to birds and mammals, most amphibians and reptiles have poor dispersal capabilities and are unlikely to emigrate to isolated islands. Similarly, species with small island populations are especially vulnerable to local extirpations. (MacArthur and Wilson 1967, Schoener 1974.) These factors probably facilitated the demise of red-legged frogs and western pond turtles at the Presidio.

For amphibians and reptiles, the Presidio is an isolated island surrounded by salt water and urbanization. Common and widespread species such as California slender salamanders and alligator lizards occupy all woodland habitats and appear to have stable populations at the Presidio. In contrast, the Presidio's isolated conditions could contribute to the future losses of rare and extremely rare species such as Coast Range newts, western skinks, Pacific rubber boas, western yellow-bellied racers, sharp-tailed snakes, Pacific ringneck snakes, California kingsnakes, Pacific gopher snakes, Santa Cruz garter snakes, and northern Pacific rattlesnakes.

Birds

More than 85% of all vertebrates that have been observed at the Presidio are birds (Table L-3). However, the vast majority of these are spring and fall migrants or winter visitors that do not nest at the Presidio; 49 species have been confirmed as nesters there. Eight more species are suspected of nesting, and six species have unknown nesting status.

Birds breed throughout the Presidio because it is one of the only large areas of native and naturalized habitat on the northern tip of the San Francisco peninsula. Results of the Audubon Society surveys and those by Jones & Stokes Associates suggest that Lobos Creek and Mountain Lake are especially important habitat areas for a variety of riparian and forest breeding birds. The forests near Inspiration Point also have high value for birds because they are large, continuous stands with a diversity of tree species and understory vegetation.

Although most of its birds are migrants or nonbreeding visitors, the Presidio represents an important habitat area for these species. Aside from Golden Gate Park, the Presidio is the only large area of open space offering shelter, food, and water for migratory birds on the northern San Francisco peninsula. The forests, coastal shrublands, riparian areas, grasslands, and coastal habitats of the Presidio probably attract a high proportion of the migrant birds that land in the area.

Four bird species (the common poorwill, horned lark, western bluebird, and Lawrence's goldfinch) have not been seen at the Presidio for 50 or more years. Twelve other species have been recorded there only once or a few times (the yellow-billed loon, magnificent frigatebird, tundra swan, northern goshawk, common moorhen, glaucous gull, Townsend's solitaire, northern parula, Tennessee warbler, blackpoll warbler, magnolia warbler, and bobolink). The Presidio should not be considered part of the normal range of any of these species.

Three introduced bird species (rock doves, European starlings, and house sparrows) are present at the Presidio. These species may be displacing native species from local nesting habitats here, as they do elsewhere in North America. The starling is present in most habitats and probably excludes native birds from their nesting cavities and roosting sites. In contrast, the rock dove and house sparrow rarely venture far from buildings and developed areas and do not threaten most birds in native and naturalized habitats of the Presidio.

Brown-headed cowbirds are native to North America but not to California; they were first reported in the state in the 1860s, and by 1930 they had expanded their range north as far as the Bay Area (Laymon 1987). In the following decades, nest parasitism by this species caused the extirpation of many lowland, passerine bird species. Nest parasitism by cowbirds continues to threaten songbirds nesting at the Presidio; for example, Trail and Baptista (1993) found that 40-50% of the Nuttall's white-crowned sparrows in San Francisco are parasitized by cowbirds, threatening the long-term survival of this subspecies in the Bay Area.

Native habitats and introduced forests of the Presidio are regionally important to nesting olive-sided flycatchers and other neotropical migrants (including most flycatchers, vireos, warblers, tanagers, and grosbeaks), locally declining species (California quail, western screech owl, wrentit, and Hutton's vireo), and at least one species (hooded oriole) at the northern limit of its breeding range. For these reasons, the Presidio is a link of vital importance to resident and migratory birds in a severely threatened, but poorly understood, portion of the Pacific Flyway.

Mammals

The current or former presence of 12 species of native mammals at the Presidio was documented by Harris (1994). Two species, the California ground squirrel and black-tailed deer, and one subspecies, the salt-marsh vagrant shrew, have been extirpated. Harris (1994) considered opossums, brush rabbits, and house mice likely to occur at the Presidio, but he did not detect these species during his study. Kurz (1983) reported Trowbridge shrews, long-tailed weasels, and gray foxes as occurring at the Presidio. These records were not supported by specific descriptions or dates, however, and Harris (1994) could not confirm their validity.

In general, the Presidio is characterized by a low diversity of small mammals (Table L-3). For example, only five species were captured by live-trapping: California voles, western harvest mice, roof rats, vagrant shrews, and ornate shrews (Harris 1994). Two species made up almost 90% of the total captures: California voles (20 captures) and western harvest mice (21 captures).

California voles and western harvest mice were captured in a wide variety of Presidio habitats, including riparian, annual grassland, dune scrub, coastal scrub, Monterey pine woodland, and Monterey cypress woodland. The most consistent feature of these habitats was the presence of dense, moist cover in the herb/grass layer; patches of blackberry thickets or ferns often were present (Harris 1994).

Valley pocket gophers are abundant throughout the Presidio, including in grasslands, shrublands, woodlands, residential areas, and the golf course. Broad-footed moles probably occur along Lobos Creek and near Inspiration Point. This species prefers moist, friable soils and is most common in moist meadow and riparian situations; it is less tolerant of dry, compact soils than the valley pocket gopher (Harris 1994).

Striped skunks and raccoons are widespread and occur in most habitats at the Presidio. Brushy sites in woodlands and riparian habitats are probably important den and foraging areas for this species. Raccoon tracks were found on more than 40% of the track plates established during this study (Harris 1994). Raccoons are very tolerant of human activity and are often found in residential and urban areas.

Three introduced mammals occupy the Presidio: feral cats, roof rats, and fox squirrels (Harris 1994). Cats are abundant throughout the Presidio and were seen in all habitat types; they left tracks on 65% of the track plates in this study (Harris 1994). Some feral cats have been captured, neutered, and released at the Presidio; others have been placed in homes by people maintaining feeding stations. Despite such efforts, some feral cats are probably reproducing at the Presidio, given their widespread occurrence and the likelihood that more cats enter (or are abandoned) from surrounding residential areas than are neutered or adopted. Juvenile cats were observed near Battery Crosby (Harris pers. comm.) and along Lobos Creek in this study.

Roof rats were captured near El Polin Spring, and they are probably also associated with buildings at the Presidio (Harris 1994). Fox squirrels are rare and have been observed by Golden Gate NRA personnel at Inspiration Point on only a few occasions. The lack of squirrels at the Presidio is curious because both fox squirrels and eastern gray squirrels are present at Golden Gate Park and tree-lined Park Presidio Boulevard, which connects the two park areas, is a potential dispersal corridor (Harris 1994).

Bats. Based on the results of acoustic surveys conducted at the Presidio, Pierson and Rainey (1995) concluded that Mexican free-tailed bats, red bats, hoary bats, California myotis, and Yuma myotis probably forage at the Presidio. By far the most abundant species, accounting for 70-90% of all identified acoustic events (in all habitats and seasons), was the Mexican free-tailed bat. The next most common species at the Presidio (in fall, winter, and spring only) was the hoary bat; all other species were rare.

The primary bat foraging area at the Presidio, especially for Mexican free-tailed bats, is Mountain Lake. The next most important habitat type, and the one with the greatest bat species diversity, is the forest edge at the interface between multi-aged forest stands and open areas. Little

acoustic activity was detected in open grasslands, coastal dunes, or in riparian habitats along Lobos Creek.

Wildlife Habitat Value Analysis

Relative Value of Forest Stands

Figure 3-10 illustrates the relative wildlife habitat values of individual forest stands at the Presidio. Table L-4 summarizes the calculated habitat variable scores for each forest stand. In general, large blocks of forest habitat with multistoried vegetation and an herbaceous or shrub understory received high rankings. Stands that are near water, that support special-status wildlife, or are continuous with other large stands usually also received high rankings. Native tree species such live oak and willows, in addition to introduced species like eucalyptus, were often associated with high rankings because of their high wildlife species diversity. The forest stands that received the highest overall wildlife habitat value rankings were the oak and willow forests at Mountain Lake and along Lobos Creek. Several large blocks of high-value habitat also dominate the central portions of the Presidio, including the areas north of the golf course and near Inspiration Point and El Polin Spring.

Intermediate-sized stands characterized by even-aged trees and limited understory vegetation were usually ranked as having moderate habitat value. Moderate-value stands are often long, narrow strips of habitat (e.g., the stands dividing the golf course fairways) where wildlife would be more likely to be disturbed than in large blocks of habitat. In the context of their urban surroundings, however, even moderate-value stands provide important wildlife habitat and are occupied by a diversity of species. Monterey pine, Monterey cypress, and linear rows of eucalyptus often characterize moderate-value stands (Figure 3-10).

Low-value stands are usually small (i.e., 1 acre or less), isolated, and dominated by even-aged trees or ornamental vegetation. Stands ranked as having low habitat value are often near roads, buildings, and other developed areas. A variety of tree species make up the low-value stands, including eucalyptus (especially even-aged, decadent stands), Monterey pine, and black acacia.

Wildlife Habitat Relationships of Forest Stand Types

Most common resident mammals, reptiles, and amphibians do not appear to distinguish among different forest types at the Presidio. For example, the occurrence of California slender salamanders, alligator lizards, ornate shrews, western harvest mice, and California voles is most closely related to the condition of the understory, where they live. In contrast, many species of birds exhibit preferences for certain forest types, even during migration.

Eucalyptus (WHI = 0.65). Despite the species' introduced status, naturalized eucalyptus groves offer important and high-value wildlife habitat. Flowering eucalyptus and the insects

Table L–4. Wildlife Variables and Habitat Values of Forest Stands at the Presidio of San Francisco

Forest Polygon #	1. # of Species	2. Polygon Size	3. Polygon Connectivity	4. Forest Condition	5. Forest Midstory	6. Forest Understory	7. Proximity to Creek or Lake	8. Special–Status Species*	Total	Total x WHI pi	Overall x Rating
C1	1	3	2	3	2	3	0	0	14	7.8	M
C2	1	2	2	4	0	4	0	0	13	7.3	M
P3	1	1	3	2	2	1	0	0	10	5.8	M
C4	1	3	3	3	2	3	0	0	15	8.4	M
A5	1	1	2	2	0	2	0	0	8	3.5	L
CP6	2	1	0	2	0	3	0	0	8	4.6	L
E7	1	2	1	2	2	3	0	0	11	7.2	M
E8	1	3	2	2	0	3	0	0	11	7.2	M
E9	1	2	2	2	1	5	0	5	18	11.7	H
E10	1	1	2	2	1	4	0	0	11	7.2	M
E11	1	3	1	2	2	4	0	0	13	8.5	M
E12	1	2	0	2	2	4	0	0	11	7.2	M
C13	1	1	2	3	0	3	0	0	10	5.6	M
E14	1	1	1	2	2	4	0	0	11	7.2	M
C15	1	1	1	2	0	1	0	0	6	3.4	L
A16	1	2	1	3	0	0	0	0	7	3.1	L
PC17	2	1	0	2	1	2	0	0	8	4.6	L
E18	1	0	0	2	0	4	0	0	7	4.6	L
E19	1	3	1	2	0	5	0	0	12	7.8	M
E20	1	3	1	3	0	1	0	0	9	5.9	M
CP21	2	3	1	2	0	3	0	0	11	6.4	M
C22	1	3	1	1	0	3	0	0	9	5.0	L
CP23	1	3	1	1	0	4	0	0	10	5.8	M
CP24	2	1	1	1	0	3	0	0	8	4.6	L
P25	1	1	1	1	0	4	0	0	8	4.6	L
E26	1	1	1	1	1	2	0	0	7	4.6	L
E27	1	1	2	2	2	3	0	0	11	7.2	M
C28	1	1	1	1	1	3	0	0	8	4.5	L
CPA29	1	1	1	2	0	3	0	0	8	4.6	L
P30	1	1	0	1	0	4	0	0	7	4.1	L
E31	1	1	2	2	2	4	0	0	12	7.8	M
CP32	1	1	2	3	0	0	0	0	7	4.1	L
E33	1	1	0	1	2	2	0	0	7	4.6	L
P34	1	1	1	1	0	2	0	0	6	3.5	L
E35	1	1	1	1	1	2	0	0	7	4.6	L
CP36	2	2	1	1	0	2	0	0	8	4.6	L
C37	1	1	1	1	0	3	0	0	7	3.9	L
C38	1	1	1	2	0	1	0	0	6	3.4	L
P39*	1	1	1	2	0	3	0	0	8	4.6	L
A40	1	1	1	2	2	0	0	0	7	3.1	L
C41	1	2	2	1	0	3	0	0	9	5.0	L
E42	1	2	3	2	2	2	0	0	12	7.8	M
CP43	2	2	2	3	1	4	0	0	14	8.1	M
C44	1	1	1	2	0	3	0	0	8	4.5	L

Table L–4. Continued

E45	1	1	2	2	2	1	0	0	9	5.9	M
PC46	2	2	1	2	1	4	0	0	12	7.0	M
C47	1	2	1	2	0	3	0	0	9	5.0	L
E48	1	3	4	2	0	4	0	0	14	9.1	H
C49	1	2	3	1	1	3	0	0	11	6.2	M
C50	1	3	2	1	0	3	0	0	10	5.6	M
C51	1	2	1	1	0	3	0	0	8	4.5	L
C52	1	4	2	1	1	3	0	0	12	6.7	M
E53	1	4	2	2	4	4	0	0	17	11.1	H
E54	1	1	0	1	2	2	0	0	7	4.6	L
E55	1	1	0	1	2	2	0	0	7	4.6	L
C56	1	3	1	1	0	3	0	0	9	5.0	L
C57	1	3	1	1	0	3	0	0	9	5.0	L
C58	1	2	1	1	0	3	0	0	8	4.5	L
C59	1	3	2	1	0	3	0	0	10	5.6	M
E60	1	2	2	1	5	1	0	0	12	7.8	M
E61	1	2	1	1	1	1	0	0	7	4.6	L
P62	1	1	3	2	0	2	0	0	9	5.2	M
E63	1	3	3	2	2	4	0	0	15	9.8	H
E64	1	5	4	2	3	4	0	0	19	12.4	H
C65	1	4	3	1	1	3	0	0	13	7.3	M
P66	1	2	2	1	0	3	0	0	9	5.2	M
A67	1	1	1	2	3	1	0	0	9	4.0	L
A68	1	3	1	2	3	1	0	0	11	4.8	L
C69	1	2	2	2	0	3	0	0	10	5.6	M
P70	1	1	2	2	0	3	0	0	9	5.2	M
C71	1	3	1	2	0	3	0	0	10	5.6	M
E72	1	1	2	2	1	3	0	0	10	6.5	M
E73	1	2	3	2	2	3	0	0	13	8.5	M
R74	1	1	3	3	1	2	0	0	11	5.7	M
R75	1	1	5	3	1	2	0	0	13	6.8	M
P76	1	1	2	1	0	3	0	0	8	4.6	L
E77	1	3	2	2	2	3	0	0	13	8.5	M
PC78	2	1	1	1	0	2	0	0	7	4.1	L
E79	1	1	2	3	0	0	0	0	7	4.6	L
E80	1	2	1	3	0	0	0	0	7	4.6	L
E81	1	1	1	3	0	0	0	0	6	3.9	L
C82	1	4	3	1	0	3	0	0	12	6.7	M
C83	1	1	2	2	0	3	0	0	9	5.2	M
C84	1	3	2	2	0	1	0	0	9	5.0	L
E85	1	1	2	3	1	3	0	0	11	7.2	M
CP86	2	2	1	3	1	4	0	0	13	7.5	M
CP87	2	3	2	1	2	3	0	0	13	7.5	M
P88	1	3	2	2	2	4	0	0	14	8.1	M
E89	1	1	1	4	1	1	0	0	9	5.9	M
C90	1	1	2	1	0	4	0	0	9	5.0	L

Table L–4. Continued

C91	1	3	3	1	0	3	0	0	11	6.2	M
E92	1	5	5	2	3	4	0	0	20	13.0	H
E93	1	3	2	2	4	4	0	0	16	10.4	H
E94	1	3	1	2	3	4	0	0	14	9.1	H
E95	1	3	1	2	3	4	0	0	14	9.1	H
E96	1	1	2	2	3	4	0	0	13	8.5	M
CP97	2	1	2	3	0	3	0	0	11	6.4	M
E98	1	3	1	2	1	3	0	0	11	7.2	M
C99	1	2	3	1	0	1	0	0	8	4.5	L
E100	1	3	3	2	3	2	0	0	14	9.1	H
A101	1	3	3	2	3	1	0	0	13	5.7	M
P102	1	3	4	2	0	3	0	0	13	7.5	M
R103	1	1	3	4	0	1	0	0	10	5.2	M
A104	1	1	2	4	3	3	0	0	14	6.2	M
R105	1	2	1	4	0	1	0	3	12	6.2	M
RPC106	3	2	4	2	4	5	0	0	20	10.4	H
A107	1	1	4	2	3	1	0	0	12	5.3	M
C108	1	2	4	1	0	3	0	0	11	6.2	M
E109	1	4	4	1	3	4	0	0	17	11.1	H
E110	1	2	1	2	2	3	0	0	11	7.2	M
CP111	2	1	1	3	0	3	0	0	10	5.8	M
A112	1	1	2	2	3	1	0	0	10	4.4	L
E113	1	5	4	2	1	3	0	0	16	10.4	H
E114	1	3	0	2	0	1	0	0	7	4.6	L
P115	1	3	3	2	0	3	0	0	12	7.0	M
E116	1	1	3	2	3	2	0	0	12	7.8	M
A117	1	1	2	2	1	1	0	0	8	3.5	L
C118	1	1	4	3	0	1	0	0	10	5.6	M
C119	1	3	1	3	0	3	0	0	11	6.2	M
P120	1	3	2	4	0	1	0	0	11	6.4	M
E121	1	2	3	3	2	1	0	0	12	7.8	M
E122	1	1	1	2	0	2	0	0	7	4.6	L
CPE123	3	2	2	2	1	3	0	0	13	7.5	M
E124	1	1	2	2	0	2	0	0	8	5.2	M
P125	1	2	1	0	0	3	0	0	7	4.1	L
C126	1	3	4	0	0	2	0	0	10	5.6	M
P127	1	1	5	2	0	1	0	0	10	5.8	M
P128	1	1	4	2	0	1	0	0	9	5.2	M
C129	1	1	3	2	2	1	0	0	10	5.6	M
E130	1	3	3	2	1	2	0	0	12	7.8	M
C131	1	5	3	1	1	3	0	0	14	7.8	M
A132	1	2	2	4	3	3	0	0	15	6.6	M
R133	1	1	1	5	0	1	0	0	9	4.7	L
C134	1	2	3	1	0	1	0	0	8	4.5	L
P135	1	4	4	2	0	4	0	0	15	8.7	M
R136	1	2	5	4	0	1	0	5	18	9.4	H

Table L–4. Continued

E137	1	1	5	4	0	4	0	5	20	12.4	H
P138	1	3	3	2	0	4	0	5	18	10.4	H
C139	1	2	1	4	1	3	0	0	12	6.7	M
C140	1	1	2	4	2	3	0	0	13	7.3	M
A141	1	1	1	3	5	1	0	0	12	5.3	M
E142	1	4	3	2	2	4	0	0	16	10.4	H
C143	1	3	2	1	0	3	0	0	10	5.6	M
CP144	1	2	1	2	0	3	0	0	9	5.2	M
P145	1	1	1	3	0	3	0	0	9	5.2	M
C146	1	1	0	2	0	3	0	0	7	3.9	L
P147	1	1	2	2	0	3	0	0	9	5.2	M
E148	1	2	2	3	1	2	0	0	11	7.2	M
E149	1	1	3	2	2	2	0	0	11	7.2	M
C150	1	5	3	2	0	4	0	0	15	8.4	M
C151	1	2	3	1	0	3	0	0	10	5.6	M
PEC152	1	1	3	2	1	1	0	0	9	5.2	M
C153	1	1	3	1	1	3	0	0	10	5.6	M
P154	1	1	2	1	3	3	0	0	11	6.4	M
E155	1	3	2	2	0	1	0	0	9	5.9	M
C156	1	3	4	1	0	3	0	0	12	6.7	M
E157	1	3	4	1	1	3	0	0	13	8.5	M
P158	1	1	1	2	0	3	0	0	8	4.6	L
E159	1	1	2	2	0	4	0	0	10	6.5	M
C160	1	1	2	2	0	4	0	0	10	5.6	M
C161	1	1	3	2	1	3	0	0	11	6.2	M
E162	1	1	2	2	0	3	0	0	9	5.9	M
W163	1	2	2	4	3	3	1	0	16	10.6	H
P164	1	3	4	2	0	1	1	0	12	7.0	M
C165	1	1	3	3	0	3	0	0	11	6.2	M
P166	1	2	1	2	0	1	0	0	7	4.1	L
C167	1	3	2	3	0	3	0	0	12	6.7	M
C168	1	3	2	3	0	3	1	0	13	7.3	M
C169	1	3	3	3	0	3	2	0	15	8.4	M
CP170	2	5	2	3	0	3	3	5	23	13.3	H
P171	1	1	4	1	0	1	1	0	9	5.2	M
E172	1	3	3	2	1	1	0	0	11	7.2	M
P173	1	3	3	1	0	1	0	0	9	5.2	M
CP174	2	3	1	3	0	3	0	0	12	7.0	M
O175	1	3	4	4	2	4	5	0	23	15.4	H
W176	1	4	3	4	3	3	5	0	23	15.2	H
P177	1	3	1	2	0	3	2	0	12	7.0	M
E178	1	1	2	2	1	2	0	0	9	5.9	M
C179	1	2	3	0	0	2	0	0	8	4.5	L
E180	1	2	1	1	0	1	1	0	7	4.6	L
C181	1	2	1	2	0	1	0	0	7	3.9	L
C182	1	2	2	2	0	1	1	0	9	5.0	L
E183	1	1	1	2	1	2	2	0	10	5.8	M

Table L–4. Continued

C184	1	4	2	0	0	2	0	3	12	6.7	M
P185	1	1	1	2	0	3	0	0	8	4.6	L
C186	1	3	2	2	0	1	1	0	10	5.6	M
P187	1	1	2	2	0	3	0	0	9	5.2	M
C188	1	2	1	2	0	1	0	0	7	3.9	L
C189	1	2	2	2	0	1	1	0	9	5.0	L
P190	1	1	2	1	0	3	1	0	9	5.2	M
P191	1	3	1	2	0	3	0	0	10	5.8	M
C192	1	1	3	2	0	1	1	0	9	5.0	L
P193	1	1	3	2	0	3	1	0	11	6.4	M
E194	1	1	3	2	1	2	1	0	11	7.2	M
E195	1	1	1	2	1	2	1	0	9	5.9	M
C196	1	2	1	2	0	1	2	0	9	5.0	L
C197	1	1	2	2	0	1	2	0	9	5.0	L
E198	1	1	3	2	1	1	2	0	11	7.2	M
C199	1	2	1	2	0	1	2	0	9	5.0	L
C200	1	2	3	2	0	1	2	0	11	6.2	M
E201	1	4	2	2	1	2	2	0	14	9.1	H
E202	1	3	2	2	1	2	1	0	12	7.8	M
P203	1	1	2	2	0	3	0	0	9	5.2	M
C204	1	4	2	2	0	1	1	0	11	6.2	M
P205	1	1	5	2	0	3	0	0	12	7.0	M
E206	1	3	2	2	1	4	0	0	13	8.5	M
C207	1	1	3	2	0	1	0	0	8	4.5	L
C208	1	2	1	3	0	1	0	0	8	4.5	L
C209	1	1	0	3	0	1	0	0	6	3.4	L
C210	1	2	1	3	0	1	0	0	8	4.5	L
C211	1	2	2	3	0	1	0	0	9	5.0	L
P212	1	1	2	2	0	2	0	0	8	4.6	L
C213	1	3	1	3	0	1	0	0	9	5.0	L
P214	1	1	1	2	0	3	0	0	8	4.6	L
C215	1	3	2	2	0	1	0	0	9	5.0	L
C216	1	1	1	3	0	1	0	0	7	3.9	L
C217	1	2	1	3	0	1	0	0	8	4.5	L
C218	1	1	1	3	0	1	0	0	7	3.9	L
C219	1	1	1	3	0	1	0	0	7	3.9	L
C220	1	1	1	3	0	1	0	0	7	3.9	L
C221	1	3	1	3	0	1	0	0	9	5.0	L
E222	1	3	3	2	1	2	0	3	15	9.8	H
C223	1	2	1	2	1	2	0	0	9	5.0	L
C224	1	1	0	3	0	1	0	0	6	3.4	L
C225	1	2	1	3	0	1	0	0	8	4.5	L
C226	1	1	2	1	1	3	0	0	9	5.0	L
P227	1	1	1	2	0	3	0	0	8	4.6	L
W228	1	2	2	4	3	1	5	0	18	11.9	H
C229	1	1	2	2	0	1	2	0	9	5.0	L

Table L–4. Continued

P230	1	1	2	2	0	3	2	0	11	6.4	M
P231	1	1	2	2	1	5	2	0	14	8.1	M
W232	1	3	4	4	3	1	5	0	21	13.9	H
CP233	2	1	3	2	0	5	5	0	18	10.4	H
E234	1	1	3	3	0	1	5	0	14	9.1	H
W235	1	3	2	4	3	1	5	0	19	12.5	H
Mean										6.3	
Std. Dev.										2.2	

attracted to them draw large numbers of migratory birds, including Anna's hummingbirds, Allen's hummingbirds, red-breasted sapsuckers, ruby-crowned kinglets, golden-crowned kinglets, American robins, cedar waxwings, yellow-rumped warblers, western tanagers, and black-headed grosbeaks. The sturdy branches and tall stature of eucalyptus provide suitable nesting sites for red-shouldered hawks, red-tailed hawks, and other raptors. Cavities excavated in eucalyptus offer habitat for various woodpeckers and other cavity-nesting species. Screech owls observed at the Presidio are suspected of nesting in a eucalyptus stand.

Monterey Pine (WHI = 0.58) and Monterey Cypress (WHI = 0.56). Monterey pine and Monterey cypress offer nearly identical habitat values to wildlife at the Presidio. These introduced conifers attract large numbers of chestnut-backed chickadees, pygmy nuthatches, and American robins; they are also attractive to Hammond's flycatchers, dusky flycatchers, hummingbirds, Steller's jays, red-breasted nuthatches, brown creepers, hermit warblers, red crossbills, purple finches, and evening grosbeaks. They also provide roosting sites for larger species such as pigeons, doves, owls, crows, and ravens. Similar to eucalyptus, pine and cypress offer sturdy nesting sites for raptors.

Redwood (WHI = 0.52). The only significant stands of redwoods at the Presidio are near Inspiration Point. These stands have especially high wildlife values because they comprise large, vigorous trees that are contiguous with large stands of eucalyptus and Monterey pine. The redwood stands support most of the same species that are found in nearby pine and cypress forests. Fewer species were found in the redwood stands during the Audubon Society surveys, however, perhaps because they occupy such a small acreage compared to most other forested habitats at the Presidio. In addition to large numbers of resident and migratory birds, a pair of western screech owls were detected roosting in a redwood tree during a 1994 survey (Stallcup pers. comm.), although the usual native habitat of this species is oak woodland.

Coast Live Oak (WHI = 0.67). Despite its relatively small acreage at the Presidio, coast live oak woodlands receive heavy use by migratory and nesting birds. These native trees attract a host of insects that, in turn, attract insectivorous birds. Species such as solitary vireos, Hutton's vireos, black-throated gray warblers, lazuli buntings, rufous-sided towhees, California towhees, and chipping sparrows are often associated with live oaks at the Presidio.

Willow Riparian (WHI = 0.73). Riparian willows and other trees associated with Mountain Lake and Lobos Creek are perhaps the most important nesting and migratory bird habitats at the Presidio. The combination of dense, multistoried vegetation in association with water provide essential habitat for species such as flycatchers, vireos, warblers, grosbeaks, and sparrows (Table L-3). The fencing and thick vegetative cover near Lobos Creek make many areas nearly inaccessible, and wildlife in that area is rarely disturbed. Similarly, much of the shoreline of Mountain Lake is inaccessible except by boat and provides secluded resting areas for wildlife.

Ornamental (WHI = 0.44). Ornamental plantings usually have relatively low wildlife value compared to native habitats, such as live oak and riparian forests, or to naturalized forests of pine, cypress, and eucalyptus. Ornamental plantings are usually near buildings, roads, and other developed areas where wildlife are disturbed frequently. Many ornamental species produce fruits and berries that attract large numbers of scrub jays, northern mockingbirds, cedar waxwings,

American robins, and European starlings. Flowering ornamental shrubs attract Anna's hummingbirds, Allen's hummingbirds, and possibly rufous hummingbirds. Palm trees are used for nesting by hooded orioles and American kestrels.

DISCUSSION

The Presidio as an Island

At the tip of the San Francisco peninsula, the Presidio lies within a region inhabited by vertebrate species typical of the southern and inner Coast Ranges (Hooper 1944, Grinnell and Miller 1944, Ingles 1965, Hall 1981, Stebbins 1985). The Presidio could be a northern-range limit for amphibian, reptile, mammal, or bird species (or subspecies) because many taxa have range limits that coincide with some portion of the San Francisco Bay-Delta system (Hooper 1944, Grinnell and Miller 1944, Hall 1981, Stebbins 1985).

Despite the large number of vertebrate taxa that could potentially occur at the Presidio based on their geographical ranges, the diversity of relatively sedentary taxa (e.g., amphibians, reptiles, and mammals) is low (Table L-3). Some of the historically present habitats, such as dune, dune scrub, and salt marsh, have been greatly reduced or eliminated. Remaining dune scrub, riparian, grassland, and oak woodland occupy small areas of land. Other habitats are entirely artificial, and are dominated by introduced trees, such as eucalyptus, Monterey pine, and Monterey cypress. Some of these woodland patches lack a well-developed understory or are decadent, even-aged stands with thick layers of coarse, woody debris on the ground.

Much of the Presidio is residential or otherwise developed land with lawns, buildings, roads, and human activity. In addition to the activities of people working and living on the Presidio, many people hike, run, bike, walk pets, or drive through the Presidio. In summary, many existing habitats for most native vertebrates at the Presidio are somewhat isolated, fragmentary, disturbed, and dominated by exotic plant species. Despite all of these factors that reduce the quality of Presidio wildlife habitats, however, many large, vigorous forest stands have extremely high value and receive extensive use by native wildlife. Overall, forested habitats at the Presidio have higher wildlife habitat values from grasslands, shrublands, and other local plant communities.

Conclusions

The low diversity of mammals, reptiles, amphibians, and breeding birds at the Presidio reflects the area's complex history of habitat modification, human disturbance, and isolation of habitat fragments. The overall scarcity of such habitats on the northern tip of the San Francisco peninsula, however, contributes to the relative importance of Presidio habitats to regional wildlife populations. Similarly, although the wildlife diversity of the Presidio may seem low compared to

that of a native forest area (e.g., Marin County), a large number of species find suitable habitat in the midst of a major urban area, which is a significant contribution to area wildlife.

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Appendix M. Forest Management Activity Calendar and Equipment

Forest Management Activity Calendar and Equipment

FOREST MANAGEMENT ACTIVITY CALENDAR AND EQUIPMENT

This appendix describes some aspects of forest management designed specifically for the Presidio's forests and includes:

- an annual activity calendar for forest management and
- equipment needed for forest management.

ANNUAL ACTIVITY CALENDAR FOR FOREST MANAGEMENT

All reforestation work is seasonal. New trees are planted in winter and early spring, older trees are pruned and thinned in late fall and winter, and site preparation takes place throughout summer. Performing work during the proper season increases tree establishment success, diminishes pest problems, decreases maintenance requirements, and provides better protection for soil resources.

Planting and maintenance should be timed properly. Trees can be planted at any time during the year, if necessary, but survival rates may be lower and maintenance costs higher. Following seasonal patterns of reproduction and growth, however, will ensure that reforestation and maintenance work will be more successful and cost effective.

For these reasons, the following monthly calendar should be used as a guide for managing the Presidio forest. Only those activities that are seasonally dependent are included. Categories of work used in the calendar are:

- R - stand cutting and reforestation,
- M - reforestation maintenance, and
- A - administrative work.

January

This month is the peak of the planting season, which starts in December. Exceptionally poor weather can delay some tree planting, but most trees should be in the ground by the end of the month. (R)

If necessary, minor pruning of seedlings and saplings should be done at this time while both trees and insects are dormant. Emergency repair of storm damage will be necessary as older trees fail throughout the winter. (M)

Staff review of cardiopulmonary resuscitation, first aid, and other safety-related procedures should be performed. (A)

February

All reforestation work to be undertaken by park personnel or under contract during the season should be completed. Trees should be planted where hazardous trees have been removed during the previous year or where landscaping trees have failed during winter. Shrubs and wildflowers should be planted in the 5- to 7-year-old reforestation areas. (R)

The slower growing tree species, grown for the next season by onsite or contract nurseries, should be germinated. (R)

Saplings not thinned during the previous December because of soil or weather conditions should be removed and chipped. (M)

Publicity should begin to recruit community volunteers for spring planting and planting maintenance. (A)

March

Volunteers should be organized to plant trees on Arbor Day. (R)

Areas considered for cutting in summer should be assessed to determine desired tree species, planting stock availability, irrigation needs, visual impact, and accessibility. (R)

Weather permitting, weed control should be the most important activity for the month. The status of trees damaged by winter storms should be reassessed, and those considered too hazardous to repair should be scheduled for removal. (M)

April

Temporary irrigation lines and water tanks should be installed where needed. (M)

Hazard tree removal, weeding, and watering schedules should be developed and implemented as weather permits. (M)

Community volunteers should be used to weed reforestation plots and remove invasive species for native plant communities. (M)

May

Monterey pine and cypress should be germinated midmonth so that they will be the proper planting size by winter. The required equipment and specialized personnel should be scheduled for the annual stand-cutting program. (R)

All reforestation plantings should be evaluated annually for vigor; pathogenic influences; and need for thinning, weeding, pruning, and replanting. (R)

Plantings should be weeded and watered. (M)

June, July, August, and September

Stand cutting should occur during this period, but generally after July 15 to avoid conflicts with bird breeding, in compliance with the Migratory Bird Treaty Act. (R)

Container stock awaiting use should be transplanted into larger containers so that root growth is not impeded. (R)

Specialized safety training should be provided for stand-cutting crews. (R)

Watering should be performed as discussed in Chapter 6 of the natural resource inventory under "Planting and Reforestation". Routine weeding should be done to extend the interval between waterings. (M)

Prepare budget, personnel, and equipment requests for subsequent fiscal year. (A)

October and November

All plantings less than 3 years old should be inspected for mortality and stress-related problems. Trees should be marked in plots that are to be thinned. Planting areas should be cleared of all competing vegetation and woody debris that will hinder winter planting because most areas will not be accessible to vehicles until spring. (M)

Weeding and watering should be diminished gradually and should be terminated when fall rains begin. (M)

The areas selected for planting should be mapped, and the number of trees and a planting sequence should be established. Trees that are not grown under contract, such as those from the California Department of Forestry and Fire Protection, should be ordered. Trees planned for winter thinning should be marked. San Francisco observes Arbor Day on November 1 and this day should be used to educate the public about the Presidio's reforestation program. (A)

December

Tree planting should begin, weather permitting. Tree roots grow during the winter, so it is important to plant as soon as possible following the onset of winter rains. Special planting prescriptions that require scattering pregerminated seeds, planting large stock, and planting in extremely sandy soils or windy locations should be accomplished first. Thinning of the older stands should begin as soon as insects have become dormant. (R)

Minor pruning of the smaller trees should be performed. All woody debris should be taken offsite or chipped onsite to prevent insect infestation later. (M)

Additional patrolling of the forest should be scheduled during the weeks before Christmas to prevent tree theft in reforested areas. Equipment maintenance, ordering, and testing should take place. Nursery contracts establishing tree numbers and species for the following year should be consummated. Yearly goals should be evaluated and the next year's goals established. (A)

EQUIPMENT FOR FOREST MANAGEMENT

The following equipment is appropriate to use for tree removal activities.

- **Pickup trucks:** The pickup truck is the primary personnel transporter, equipment mover, and general work tool for reforestation crews. Crews should use the most heavy duty pickup truck that a crew member can drive or one with a three-quarter-ton

or 1-ton load capacity. Because most work will be done off-road, four-wheel drive is necessary. Towing packages consisting of large engines, low-ratio rear ends, and transmission coolers are useful in extending the vehicle life. Other useful options are dump beds (pickup bed lift), utility boxes, winches, and crew cabs.

- **Tractors:** Because front-end loaders and other tracked equipment presently used for these purposes have damaged the soil and adjacent trees, two types of tractors should be considered for stand cutting and reforestation: a heavy-duty skidder and a small farm tractor.

  An average mature tree weighs about 15 tons. The most desirable tractor to move fallen trees of this size or larger is a skidder equipped with a winch. This tractor can also be used to fell hazardous or difficult trees in sensitive areas. Crew members must be specially trained to operate this tractor.

  A small, four-wheel-drive farm tractor does not have the pulling power of a heavy-duty skidder but, with additional labor, it can move trees in smaller pieces. The farm tractor with a three-point hitch can also serve as a weed tiller for revegetation maintenance, a stump grinder, a spray rig for watering and weed management, a chipper for use where trailer access is limited by terrain, a ditch digger for temporary irrigation lines, an auger for tree planting at difficult sites, and a bucket to load and spread chips and move small pieces of wood into pickups. Although an experienced crew member can use a tractor of this size, providing special training for the operators would ensure greater safety.

- **Chippers:** Two kinds of chippers are available, the flail and disk type. The flail-type chipper, which is currently used by the Presidio staff, is highly unreliable. This type of chipper needs constant attention, and its use for large chipping operations is infeasible. The disk type is a slower but safer chipper that can handle branches and tree stems of much larger diameter. Although the disk type breaks down much less often, all chippers require frequent maintenance. Equipment quality, preventive maintenance, operator care, availability of parts, and the presence of a back-up chipper are the keys to a successful chipping operation.

- **Winch/dump truck:** A specialized truck is needed to handle large tree trunks and roots. The winch can perform many of the operations of the large tractor (noted above). This equipment can also tow tractors, chippers, and slip-on watering tanks.

- **Trailer:** Moving tractors, stump grinders, ditch diggers, wood chips, and soil to and from work sites will require a trailer. This trailer should have the capability to be lowered mechanically or hydraulically so that equipment can be driven onto it.

- **Stump grinder:** A stump grinder must be of high quality and receive regular maintenance. The ideal stump grinder is a four-wheel-drive vehicle that can move on slopes.

- **Chainsaws:** Equipment quality and uniformity are important. All saws used by the Presidio staff should be the same brand and model. Such product uniformity is important for maintenance, employee safety, and training.

- **Climbing gear:** New equipment is being put on the market regularly. Some of the new climbing gear has the advantages of better back support for climbers, to reduce back-related stresses, and improved safety features.

- **Cables and ropes:** Over the years, the strength and handling characteristics of ropes and cables have been greatly improved. Nonetheless, all ropes and cables should be periodically replaced.

- **Winches and blocks:** Modern equipment should be acquired for ease of handling and safety. Using winches, cables, and blocks for tree removal is a cost-effective but dangerous procedure, and proper equipment is essential.

- **Radios:** Most of the reforestation work is in off-road areas where heavy equipment is in constant use. Mobile radios are necessary for employee safety and to coordinate equipment use.

- **Safety gear:** Tree cutting is one of the most dangerous occupations for forest crews. The California Occupational Safety and Health Administration and the California Department of Agriculture require that specific equipment be used in this activity. Because these requirements change every year, these agencies should be contacted regularly and safety equipment should be updated as needed.