San Bruno Mountain
Habitat Management Plan 2007

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San Bruno Mountain Habitat Conservation Plan

San Mateo County Parks Department

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Clockwise from bottom left: San Bruno elfin butterfly larvae; mission blue butterfly; Southeast Ridge grasslands, San Bruno Mountain; Viola pedunculata, (host plant for the callippe silverspot butterfly); callippe silverspot butterfly.
Photos by Patrick Kobernus and Victoria Harris.

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EXECUTIVE SUMMARY

San Bruno Mountain is an island of natural open space hosting a unique assemblage of plants and animals. The Mountain is ecologically rich with nine native plant community types including large areas of native coastal grasslands, coastal scrub, riparian scrub, and oak woodlands. Three federally listed endangered butterflies — the mission blue, callippe silverspot, and San Bruno elfin — and a variety of rare plants, are present within the San Bruno Mountain Habitat Conservation Plan (HCP) area. Though the butterflies are rare in other parts of their range these species continue to be locally abundant within the Mountain's grasslands. The conservation and management of the Mountain's grassland habitat is thus critical for the listed butterflies. Habitat for another special status species, the bay checkerspot butterfly (federally threatened) is also present on San Bruno Mountain. Though this species has not been recorded on San Bruno Mountain since 1984, grassland habitat for this species is still present.

The purpose of the 2007 Habitat Management Plan is to provide a management and monitoring plan for the protection and management of: a) the habitat of the mission blue, callippe silverspot, San Bruno elfin and bay checkerspot butterflies, and b) the overall native ecosystem of San Bruno Mountain. This Habitat Management Plan is an implementation plan for the management and monitoring activities authorized in the HCP and is based on lessons learned from habitat management activities conducted over the past 25 years. These efforts have protected the core habitat areas (comprising approximately 1,290 acres) of the mission blue, callippe silverspot, and San Bruno elfin butterfly populations from being overtaken by weed infestations. These efforts however have focused on the highest priority invasive species and current management and funding are incapable of controlling all invasive species that are present on the Mountain. Though the habitat of the San Bruno elfin butterfly was not impacted by development activities authorized through the HCP, the habitat management programs funded through the HCP and described in this plan include management of this species' habitat because it overlaps with portions of the habitat of the mission blue and callippe silverspot butterflies.

The San Bruno Mountain HCP provided a mechanism by which approximately 2,750 acres would be protected and managed as conserved habitat, approximately 360 acres would be developed, and approximately 270 acres would be temporarily disturbed through development activities and restored to native habitat. While restoration of lands disturbed through development activities is an important component of the HCP, it is the management of the undisturbed conserved habitat (approximately 80% of which was protected on San Bruno Mountain) that is the key to reasonably insuring the survival of the endangered species. "Reliance on preservation rather than restoration" is one of the Guiding Principles of the SBM HCP (Volume One, San Bruno Mountain HCP, 1982), and continued management of the conserved areas is the most important component of HCP management.

The San Bruno Mountain HCP provides a funding mechanism to protect and manage habitat for the mission blue, callippe silverspot and San Bruno elfin butterflies on San Bruno Mountain. The HCP currently provides funding that is used to address the highest priority threats to the endangered species habitat. In addition to the HCP-funded management, several grant funded habitat management and restoration projects have been conducted on San Bruno Mountain within the last 10 years (Figure 22). These projects have fostered more community involvement on the Mountain and have resulted in the removal of significant stands of invasive species. These projects are described in more detail within the San Bruno Mountain HCP Annual Reports (http://www.traenviro.com/sanbruno/sbmhcp.htm).

Most (approximately 60%) of the annual HCP budget is used for managing the conserved habitat on San Bruno Mountain, whereas the remaining portions of the budget are used for administration, habitat restoration, and monitoring the endangered species. Managing the conserved habitat has consisted of using hand control, herbicide and mowing to protect the native plant communities and endangered species habitat from being overtaken by invasive weeds. Restoration work has consisted of creating 'habitat islands' through replanting of the endangered butterflies' host and nectar plants in suitable locations. In the past 5 years (2003 – 2007) approximately 6% of the annual HCP budget has been used to create and manage habitat restoration islands. Additional restoration work is conducted through developer funded and grant funded restoration projects on the Mountain. Though a relatively low amount of funding has been allocated for the creation of habitat, the restoration sites provide additional habitat for the mission blue butterfly and potentially buffer the population from fluctuations due to habitat changes within the conservation area (e.g., coastal scrub succession). Creating habitat islands also provides potential educational opportunities for volunteers.

While habitat islands have been created for the mission blue butterfly, and can be created for the San Bruno elfin butterfly, it is unknown if the habitat island approach is appropriate for the callippe silverspot butterfly. The callippe relies on much larger areas (minimum of several acres) that consist of large colonies (i.e. several hundred plants or more) of its host plant *Viola pedunculata* in combination with topographic high points. Due to the high cost and difficulty of propagating viola, restoration of callippe habitat at this time is likely better served through large scale brush removal that opens up grassland habitat and allows for natural recruitment of viola.

An analysis of mission blue and callippe silverspot butterfly data recorded from 1982-2000 showed that their populations are stable in overall distribution on San Bruno Mountain. Specific areas within the conserved habitat however have shown significant negative trends in butterfly occupancy (Longcore 2004). The areas where negative trends were identified are primarily within grassland areas that have succeeded to native coastal scrub on lower elevation north-facing slopes within the Northeast Ridge, Carter-Martin area, Devil's Arroyo, the Saddle, Owl and Buckeye Canyons, Dairy and Wax Myrtle Ravines, and Reservoir Hill management units. From aerial ortho-photographic analysis, it has been determined that the amount of grassland within the conserved habitat on the Mountain decreased by an estimated 122 acres (8.6%) over a 22-year period between 1982 and 2004.

While the core endangered species' habitat on the Mountain has been protected from invasive species over the span of the HCP, the success of this work has been attenuated by the observed landscape level changes that are occurring from: 1) the expansion of coastal scrub over grassland areas, especially on north-facing slopes; and 2) the influx and expansion of herbaceous and grass weeds within the native grasslands, especially on dryer and lower elevation slopes.

In 1982, the San Bruno Mountain HCP identified the need to control the expansion of invasive species and native brush because it was concluded at that time that both processes were occurring at a relatively high rate. The HCP documented a significant expansion of coastal scrub and corresponding loss of grasslands (approximately 541 acres) between 1932 and 1981 on San Bruno Mountain (HCP Vol.1, Biological Program). In addition to coastal scrub succession, the invasive species gorse (*Ulex europaeus*) and blue gum eucalyptus (*Eucalyptus globulus*) were estimated to have expanded by 282 and 82 acres respectively during this 49-year time period; (note: the expansion of other woody invasive species such as French broom (*Genista monspessulana*), Portuguese broom (*Cytisus striatus*) and a variety of other weeds were not calculated). Based on the threats from both native and invasive brush it was estimated that in the absence of management, the mission blue and callippe silverspot butterflies could be

extirpated from the Mountain within 5 – 20 decades due to the expected loss of their grassland habitat (HCP Vol. 1, Impact on Species).

Since 1982, a management and monitoring program funded through the HCP has been carried out for 25 years with a focus on invasive species control. Invasive species were identified in the HCP as the most serious threat to the endangered species' habitat due to their high rate of spread and severe ecological impacts. Invasives species control during the period 1982 – 2007 focused on woody invasive species and has controlled and reversed the expansion of gorse, blue gum eucalyptus, French broom, Portuguese broom, and Monterey pine (*Pinus radiata*).

Management efforts over the span of the HCP have reduced gorse by approximately 290 acres (80% reduction) and eucalyptus by approximately 45 acres (30% reduction) within the conserved habitat areas (Figures 18 and 19).

While the HCP management has focused on invasive species, brush control of native coastal scrub has not been implemented on the Mountain except on a very limited basis. This is due to several factors:

- Lack of available funding and/or in-kind services (i.e., equipment and crews) to address both coastal scrub succession and invasive species management;
- Air quality regulations that have restricted available opportunities for conducting controlled burns;
- Lack of maintained fire breaks, and decreased fire break management in recent decades by fire management agencies (CDF);
- Lack of grazing infrastructure (i.e., fencing, water system) that would allow testing and reintroduction of grazing to maintain fire breaks and/or reduce brush and invasive species;
- Listing of the callippe silverspot butterfly as an Endangered Species by the US Fish and Wildlife Service (USFWS) in 1997. The callippe listing requires the Plan Operator (San Mateo County) to obtain take authorization from the USFWS prior to conducting any brush control activities that could impact the species.

The 2007 Habitat Management Plan proposes to continue the current habitat management methods, and proposes the utilization of additional methods (e.g., grazing, burning and mowing, on a more comprehensive scale in order to protect and maintain the endangered species habitat more effectively. By utilizing the additional tools of mowing, grazing and burning, the emphasis of the program would shift from an exclusive focus on 'control of invasive species' to a focus on 'changing the grassland conditions' (i.e. excessive thatch and nitrogen buildup) that favor invasive species and brush expansion on San Bruno Mountain. Implementation of this program on a broad scale while continuing current habitat management programs would require the acquisition of substantial additional funding.

The 2007 Habitat Management Plan is the result of extensive research and communications with experts in the fields of habitat management and endangered species monitoring. In addition, the Habitat Management Plan incorporates information obtained through analysis of over 20 years of butterfly monitoring data and invasive species management on San Bruno Mountain, as well as aerial photographic analysis of vegetation communities on San Bruno Mountain between the years 1946 and 2006. The Plan incorporates input received through

discussions with habitat management and restoration contractors working on San Bruno Mountain, and public comments received at five San Bruno Mountain workshops held in 2003 and 2004. In addition, the Plan has been revised based on comments received in 2006 and 2007 from US Fish and Wildlife Service Senior Biologists Jesse Wild and Craig Aubrey, the San Bruno Mountain Technical Advisory Committee, Brookfield Homes Corporation, San Mateo County Parks Division, and from peer reviews of the Plan by Alan Launer with the Center for Conservation Biology at Stanford University; David Boyd, Ecologist with California State Parks; and Lori Campbell, Research Wildlife Biologist with the USDA Forest Service. The Plan also incorporates recommendations from the US Fish and Wildlife Service Biological Opinion dated April 7, 2006 on the proposed Implementation and Amendment of the San Bruno Mountain HCP.

The Plan consists of the following changes to habitat management and monitoring, dependant upon available funding, which are designed to follow the HCP biological goals and objectives for management and monitoring, and utilize an adaptive management approach consistent with the Fish and Wildlife Service's Five Point Policy:

1) Restructure the habitat management units into a system of 13 management units based on natural transitions in vegetation, roads, and borders consistent with grassland boundaries and previous management and monitoring work (Appendix A).

2) Implement a program for testing grazing to control brush and enhancing native grasslands. If test results are positive, implement a Stewardship Grazing Program for the Mountain.

3) Significantly expand the current brush control program using hand crews such as CDF prison crews, and/or mechanical methods within non-sensitive habitat areas.

4) Expand the invasive species control program to address invasives on a broader level, using hand control and mowing to control invasive herb and grass species.

5) Expand the effectiveness monitoring program to include monitoring for nitrogen deposition and native species diversity.

6) Create and fund a Volunteer Coordinator position to oversee volunteer-based weed control and restoration programs.

7) Provide annual funding for emergency response to new invasive species infestations.

8) Expand the biological monitoring program to provide both relative population and distribution data for the callippe silverspot, mission blue, and San Bruno elfin butterflies, with the ability to incorporate trained volunteers to assist with the monitoring.

9) Monitor rare plant populations on San Bruno Mountain on a 3-year cycle (current monitoring frequency is approximately every 5 years), and conduct enhancement measures to protect and expand these populations.

10) Develop an ongoing and sustainable supply of native plants for restoration projects through agreements with local native plant nurseries and/or development of a native plant nursery on San Bruno Mountain.

11) Create and maintain additional endangered butterfly restoration sites (habitat islands), if additional funding is secured and recommended by the TAC and approved by the HCP Trust.

The Mountain has been divided into four priority categories for management purposes, as shown in Figure 1 and described below.

Priority 1: (1,292 acres)

This management area includes all core habitat for the mission blue, callippe silverspot butterfly, San Bruno elfin and bay checkerspot butterflies on San Bruno Mountain, and currently consists of approximately 30% coastal scrub, and 70% grassland. This management area has been consistently managed over the span of the HCP, though management cannot be conducted thoroughly throughout the 1292 acres on an annual basis due to limitations in funding. Management of the endangered species habitat has been accomplished within most of the unit by prioritizing management areas based on habitat value, and modifying work areas annually based on the changing distribution of invasive species.

Priority 2: (495 acres)

This management area includes less important habitat areas located on the periphery of the core habitat areas. It consists of 1) all additional grassland habitat on the Mountain that provide habitat for the mission blue, callippe silverspot, and/or bay checkerspot butterflies; and 2) all grassland areas that have converted to coastal scrub over the span of the HCP and/or provide important movement corridors for the listed butterflies.

Priority 3: (884 acres)

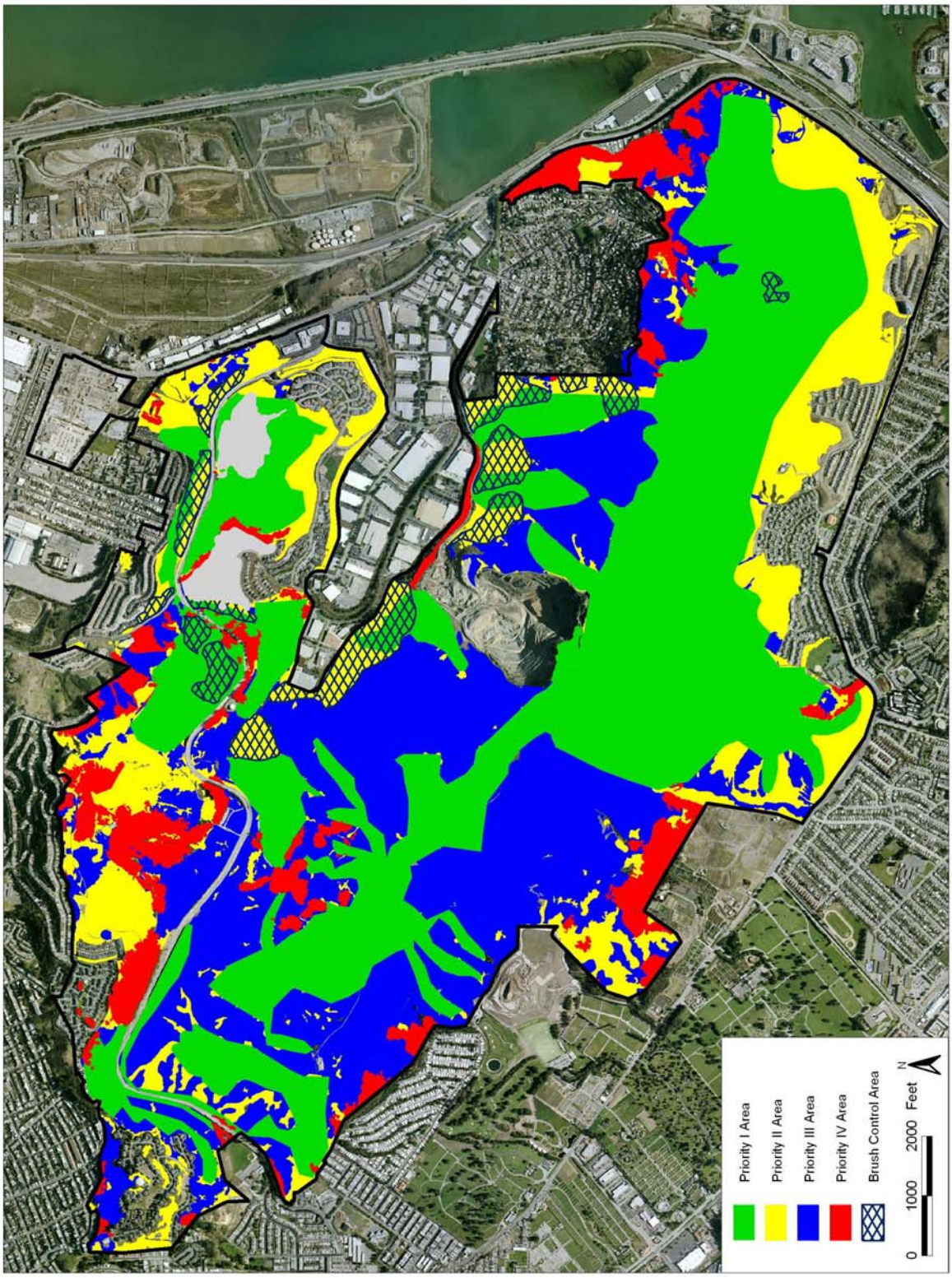
This management areas includes primarily dense stands of coastal scrub and woodland plant communities. It includes: 1) all additional coastal scrub habitat not within Priority 1; and 2) and all native oak woodlands and riparian areas on San Bruno Mountain. These areas are primarily located on the western half of the Mountain and on north- facing slopes where fog and/or brush communities limit occurrence of the butterflies. These areas generally do not support listed butterfly species however pockets of grassland butterfly habitat are present within some coastal scrub habitat. Coastal scrub is a plant community that depends on infrequent fire for regeneration and overall plant community health. Treatment of the coastal scrub within this unit utilizing the additional tools of grazing, mowing, and/or burning would require a significant increase in funding. Although butterfly habitat is limited within this management area (and it is therefore a lower management priority) this area would benefit from more frequent burning to maintain the health of this plant community.

Priority 4: (248 acres)

This management area has significant dense infestations of invasive species including eucalyptus forest, gorse and French broom. These infestations are expensive to eradicate and do not pose a significant threat to native habitats and/or to the butterflies of concern as long as they are controlled from spreading into Priority 1, 2, and 3 areas. Some of the Priority 4 areas could be restored to butterfly habitat and would be suitable for stand-alone restoration projects. Management of these areas and efforts to restore these areas are not a high priority use of HCP funds due to the high cost of conducting such work, and the long-term commitment required to obtain results. This Plan recommends that the control of these areas be pursued through grant funds or other sources of funding whenever possible. For example, the gorse control project

located in the central Saddle has been implemented under a Coastal Conservancy grant since 2002, and has expended $330,000 to control 49 acres of gorse over a 5-year period.

Figure 1. Priority I, II, III and IV Management Areas on San Bruno Mountain



Treatment of Priority areas 1, 2, and 3 on a broad scale utilizing the tools of grazing and/or burning supplemented by hand control, herbicide, and mowing would require a significant increase in funding. Without an increase in funding, the Priority 1 management area would continue to be managed with a focus on the highest priority invasive species threats using hand control, herbicide, and mowing.

This Plan establishes goals and objectives for implementation of the San Bruno Mountain HCP (Table 1) with a prime goal of maintaining a range of 1,200 – 1,800 acres of grassland on San Bruno Mountain[1]. A range of grassland acreage is suggested as a management goal since plant communities are dynamic and fluctuate over time due to climatic and biotic factors as well as from habitat management activities. The low end of this goal is based on the current extent of grassland habitat (estimated at 1287 acres in 2004), which has been shown to support stable populations of mission blue, callippe silverspot, and San Bruno elfin butterflies. The high end of the goal (1,800 acres) is consistent with the level of grassland present on San Bruno Mountain in 1981, prior to development impacts and coastal scrub succession over the past 25 years. Management shall aim to prevent the total acreage of grassland from ever dropping below 1,200 acres and shall strive for an increase in current acreage by 10-20 percent.

Between 1982 and 2004, San Bruno Mountain lost an estimated 122 acres (8.6%) of grassland habitat primarily as a result of coastal scrub succession within the HCP conservation area. The areas that have decreased in grassland extent include areas on the Northeast Ridge, Carter-Martin, Buckeye & Owl Canyons, Devil's Arroyo, Saddle, Dairy and Wax Myrtle Ravines, and Reservoir Hill. The decrease in grassland in these areas does not appear to have impacted the overall stability of the butterfly populations at this time. Reclaiming these areas through control of coastal scrub vegetation would likely benefit the butterfly populations.

Coastal scrub vegetation only becomes a threat to butterfly habitat when it reaches a high density and overtakes important butterfly host and nectar plant habitat within the grasslands. Moderate densities of coastal scrub within the grasslands of San Bruno Mountain provide important resources for the listed butterflies, such as additional nectar sources and perching sites. For these reasons, management of coastal scrub succession should be focused on reduction rather than eradication. In contrast, invasive species typically not only impact the species of concern but also impact the overall ecosystem through establishment of monocultures, and therefore control and eradication of invasive species should be pursued whenever feasible. In most cases, invasive plant species provide few resources for native wildlife species. Exceptions to this are species such as Italian thistle (*Carduus pycnocephala*), wild radish (*Raphanus sativus*) and pin-cushion plant (*Scabiosa purpurea)*, which are utilized frequently as nectar sources by mission blues and callippes. Due to the invasiveness of these species and the availability of a wide variety of native plant species as nectar sources for the butterflies, control of these invasive species is conducted.

[1] The Technical Advisory Committee recommends a goal set at the upper end of this range. The primary difficulty in setting 1800 acres as the goal for grassland acreage is that to reach this goal, a total of 600 acres of coastal scrub would need to be converted to grassland. The cost of scrub removal, grassland restoration, and ongoing maintenance is outside the scope of current and potential future SBM HCP funding. Also, as ecosystems are inherently dynamic, setting an exact acreage of habitat as being optimum does not take into account the flux of natural communities. It is understood in the ecological sciences that systems are constantly changing, and habitat goals for these systems need to reflect this.

It should be expected that butterfly habitat on San Bruno Mountain is not static and the habitat fluctuates both spatially and temporally within areas where suitable soils and slope exposures are present. Over the course of a single year habitat areas can significantly decline in quality while others may increase. For example in the El Nino year of 1998, a significant large-scale decline occurred to mission blue habitat where silver lupine (*Lupinus albifrons var. collinus*) was the dominant host plant species. This was due to a fungal infestation brought on by excessive rainfall which caused significant dieback to silver lupines. A similar dieback of silver lupine and decline in Mission blue numbers was observed in 1998 by the National Park Service in the Golden Gate National Recreation Area. In areas on San Bruno Mountain where summer lupine (*Lupinus formosus var. formosus*) plants were the dominant host plant, mission blue observations were not impacted and may have slightly increased. It is therefore important to provide as much potential habitat as possible to buffer the species from occasional large-scale declines in habitat quality that occur independent and outside the control of the Habitat Manager.

To meet the goal of maintaining 1,200 – 1,800 acres of grassland habitat this Plan recommends that all Priority 1, 2 and 3 areas be managed. The actual activities undertaken will be determined on an annual basis, based on the availability of funds, in work programs determined and approved by the HCP Trustees in consultation with the Habitat Manager, County of San Mateo, and the Technical Advisory Committee. Utilizing an adaptive management approach the activities in the work programs will address needs identified through the Plan's monitoring program. It is recommended that this Habitat Management Plan be used as a working document and the Plan and its implementation be reviewed and adapted as necessary as recommended by the TAC and approved by the HCP Trust. Past management efforts have focused on controlling the most invasive plant species within the core habitat areas (now identified as Priority 1 areas). This approach should be continued because covering all of the Priority 1 areas (approximately 1,290 acres), will provide reasonable assurance that the listed species will be protected in perpetuity. If additional funding is acquired the program should be expanded to implement invasive species control and brush control on a more broad scale within the Priority 1 areas, and begin actively managing all of the Priority 2 and 3 areas.

If supplemental funding is acquired, grazing will be tested for the first 3-5 years of the plan and if results show a significant benefit to the butterfly species, this tool would be expanded along with the tools of mowing, herbicide and hand control as supportive techniques. Grazing and/or mowing could also be used to provide fuel buffers between wildland and urban interface areas so that controlled burning may become a more reliable management tool in the future. During the experimental phase, no more than 15% of the grasslands of San Bruno Mountain (between 100 and 200 acres) would be grazed. In addition, once an effective management strategy is developed utilizing grazing and/or burning, no more than 50% (approximately 600 acres) of the Priority 1 management area would be treated on an annual basis.

While biological and habitat monitoring are important for tracking the status of the butterfly species of concern, the relationship between habitat quality and butterfly presence is well established. If funds become extremely limited in the future, it is recommended that the monitoring portion of the budget be reduced or eliminated so that the vegetation management programs could be funded to the fullest extent possible within the Priority 1 management area. This change would require the approval of the HCP Trust and the USFWS.

I. INTRODUCTION

The San Bruno Mountain Habitat Management Plan is the implementation plan for executing the goals and objectives of the San Bruno Mountain HCP. The Plan provides a detailed description of recommended habitat management activities for San Bruno Mountain. The Plan also provides estimated costs for different management activities that are intended to maintain the ecological communities on San Bruno Mountain, with special emphasis on the endangered butterflies and their grassland habitat.

San Mateo County and the cities of South San Francisco, Brisbane, and Daly City are the permittees responsible for implementing the HCP under permit from the US Fish and Wildlife Service. San Mateo County Parks Division is the HCP Plan Operator and is responsible to the permittees for managing and monitoring the conserved habitat and the endangered species within the San Bruno Mountain HCP. The County recognizes the need to maintain recreation values and public access in the park and reconciles these uses with habitat management, restoration, and butterfly monitoring programs.

Other agencies that have responsibilities on San Bruno Mountain include the City of Colma, the California Department of Fish and Game, the California Department of Forestry and Fire Protection, and California State Parks. In addition PG&E, San Francisco PUC, and many private landowners within the Brisbane Acres area are participants to the HCP. Through the Site Activity Permit process, the principle oversight mechanism for managing activities on the Mountain, there are opportunities to minimize habitat impacts from road and utility maintenance operations and other activities as well as enhancing habitat areas through reseeding, replanting, and invasive species control.

A. Purpose of 2007 Habitat Management Plan

The purpose of the 2007 Habitat Management Plan is to provide effective guidance for the management and monitoring of: a) the habitat of the mission blue, callippe silverspot, and San Bruno elfin butterflies, and b) the overall native ecosystem of San Bruno Mountain. The Habitat Management Plan provides a strategic plan for implementation of the management and monitoring programs of the San Bruno Mountain Habitat Conservation Plan. It includes biological goals and objectives and provides an implementation and adaptive management program to meet the goals and objectives, consistent with US Fish and Wildlife Service's 5-Point Policy for Reviewing Habitat Conservation Plans.

The amended San Bruno Mountain HCP goals and objectives (Table 1) includes goals directed towards protecting and restoring habitat on San Bruno Mountain by controlling invasive plant species, reversing the trend of coastal scrub succession and replanting native plant species, including the host and nectar plants for the mission blue and callippe silverspot butterflies. Though no habitat for the federally endangered San Bruno elfin butterfly was taken by development activities approved through the San Bruno Mountain HCP, the HCP conservation area encompasses the habitat of the San Bruno elfin butterfly and the management programs described in this Plan pertain to this species as well. In addition, the bay checkerspot butterfly (*Euphydras editha bayensis*), a federally threatened species once present on San Bruno Mountain, is also addressed in this Plan. The bay checkerspot butterfly has not been observed on San Bruno Mountain since a wildfire burned through its habitat in the early 1980's. The species habitat is still present on San Bruno Mountain and has been designated as Critical Habitat by the USFWS. Goals and objectives are also provided for the bay checkerspot

butterfly, and the habitat management conducted through this Plan would also benefit this species' habitat.

The Habitat Management Plan provides details on methods, proposed work areas, and expected costs to meet these goals. Important functions of the Plan include:

1) Prioritization of the work program to direct available HCP funding to highest priority habitat areas;

2) Detailed descriptions of high and low priority habitat areas to facilitate procuring separate funding for stand-alone projects;

3) Descriptions of herbicide, hand control, grazing, mowing, burning and other techniques to manage the San Bruno Mountain ecosystem.

B. Technical Advisory Committee

The HCP specifies that a Technical Advisory Committee (TAC) provide assistance in the reporting of the biological program (research, monitoring and habitat enhancement), and report on the Plan's scientific effectiveness and costs (HCP, Vol. 1, 1982). A TAC was initially formed to assist in the implementation of the HCP in 1982, and provided guidance on developing invasive species control strategies for the first few years of the plan.

The TAC was reformed in 2006 following the recommendations of the HCP Trust. The committee is currently chaired by the Director of San Mateo County Parks and participants include staff from the County (Plan Operator and Habitat Manager), weed control and restoration sub-contractors, and representatives of volunteer groups that are active on the Mountain (i.e., California Native Plant Society (CNPS), Heart of the Mountain, Friends of San Bruno Mountain and San Bruno Mountain Watch).

The TAC meets quarterly to review and recommend to the HCP Trustees annual and long-term management plans, review contractors proposed scopes of work, and initiate research to meet HCP goals. The TAC has reviewed this Habitat Management Plan and will provide ongoing review of current habitat management programs. Adaptations to the Habitat Management Plan will be made based on recommendations of the TAC and approved by the HCP Trust.

II. HABITAT MANAGEMENT PLAN GOALS AND OBJECTIVES

The SBM HCP is a results-based Habitat Conservation Plan with stated goals and objectives. The goals and objectives are both habitat-based and species-based. Monitoring includes measuring both the quantity and quality of habitat over time, and species monitoring includes monitoring the relative abundance and distribution of the callippe silverspot, mission blue, and San Bruno elfin butterflies over time.

A variety of prescriptions are described in this plan to meet the goals and objectives that relate to habitat management. Maintaining flexibility through adaptive management in applying these prescriptions is an integral component of the habitat management program.

A. Grassland Habitat and Endangered Species Goals

Goals, objectives and success criteria for each of the federally listed butterflies on San Bruno Mountain and for the overall management of the San Bruno Mountain ecosystem are stated in Table 1. Goals, objectives and success criteria for the mission blue and callippe silverspot butterflies are identical and focus on the protection of a sufficient quantity and quality of grassland to support the endangered species. Protection of sufficient densities of host plants and nectar plants within the grasslands is vital toward the long term protection of the species. Monitoring of a) the butterflies' habitat quantity; b) habitat quality; and c) populations over time is therefore necessary for tracking the status of the objectives listed in Table 1.

Goals, objectives and success criteria for the San Bruno elfin and bay checkerspot butterflies differ due to different habitat distributions and regulatory requirements for these species. Habitat for the San Bruno elfin on San Bruno Mountain has been protected within existing park lands since 1976, and this species was not impacted by HCP-approved developments. The bay checkerspot butterfly is no longer present on San Bruno Mountain, and based on its historical distribution, it also was not impacted by HCP-approved developments. The management that is recommended in this Plan is intended to both meet the goals and objectives for each species listed in Table 1, as well as benefit the overall ecosystem that supports these species.

A goal of maintaining 1,200 –1,800 acres of grassland on San Bruno Mountain is established[2]. A range of acreage is used as the management goal since plant communities are dynamic and fluctuate over time, due to climatic and biotic factors as well as from habitat management activities. The low end of this goal is based on the current extent of grassland habitat which has been shown to support stable populations of mission blue and callippe silverspot butterflies. The current estimate of grasslands on the Mountain is 1,287 acres (estimated in 2004). The high end of the goal (1,800 acres) is consistent with the level of grassland present on San Bruno Mountain in 1981, prior to development impacts and coastal scrub succession over the past 25 years. Management shall aim to prevent the total acreage of grassland from ever dropping below 1,200 acres and shall strive for an increase in current acreage by 10-20 percent

Though the historical amount of grassland in the late 19th and early 20th century was higher than 1,800 acres on San Bruno Mountain, it should be understood that this was the result of farming, grazing and burning practices that were focused on creating large open areas for cattle foraging and farming; and during this period, riparian and coastal scrub habitats were cleared with little

[2] See footnote 1 on page 8

regard for species and habitats within these communities. Historic land practices focused almost exclusively on creating open grasslands, whereas current management (due to the lack of controls on the expansion of brush) has inadvertently created conditions that have favored coastal scrub. Management instead should be focused on maintaining a range of grasslands and brush that is allowed to fluctuate within limits, (i.e., a 'dynamic equilibrium') to insure both the protection of the habitat of the endangered species as well as protection of the native coastal scrub and woodland communities on the Mountain.

The goal of 1,200 –1,800 acres assumes that the low end of the range (i.e., 1,200 acres) is sufficient to reasonably protect the endangered species from extirpation. This is based on a study conducted in 2004 on callippe silverspot and mission blue trends of butterfly occupancy on San Bruno Mountain (Longcore, 2004). This study utilizing 20 years of HCP butterfly monitoring data, determined that the butterflies' distribution has overall remained stable on the Mountain over the span of the HCP. HCP butterfly monitoring data also has not detected any declining trends in occupancy for the mission blue, callippe silverspots and San Bruno elfins over the course of the HCP in spite of losses of habitat to development (331 acres) and losses of conserved grassland habitat to coastal scrub succession (122 acres). The resilience of the butterfly populations is likely due to the continued presence of a sufficient quantity and quality of habitat for each species as a result of habitat conservation and on-going management.

While a development of an extinction risk model is ideal, the development of such a model would require extensive data collection utilizing mark and recapture techniques combined with physical habitat data to provide a thorough understanding of population dynamics of each species. Habitat quality parameters (e.g., density of host plants, invasive species, nectar plants, and hilltopping habitat for callippe) would need to be specified within the model. Creation of such a model would allow for the estimation of a minimum grassland acreage that would support a minimum viable population for each of the butterfly species. Though this data is not available, extinction probabilities for mission blue and callippe silverspot were calculated in the Endangered Species San Bruno Mountain Biological Study 1980 – 1981 (TRA, 1982), which formed the basis of the understanding of the species at that time. Based on the estimated size of the butterfly populations in 1982, and the documented rates of brush expansion on the Mountain, it was estimated that without management to control brush (native and nonnative), the endangered species would likely be extirpated from San Bruno Mountain within 5 to 20 decades (TRA 1982).

The grassland habitat of the endangered species is threatened by a combination of native brush and invasive species and active management is required to protect the habitat. Management must vary depending on the types of terrain and plant species present. Grasslands vary significantly from slope to slope, and region to region on San Bruno Mountain. Grassland areas located on steeper slopes and along the San Bruno Mountain main ridgeline tend to be of higher quality in native species composition than grasslands on lower elevation slopes. Due to higher moisture levels and less disturbance, north-facing and fog-influenced grasslands tend to have higher densities of closely overlapping native bunchgrasses and are more resilient to infestations of weedy grasses and forbs. In contrast south-facing grasslands tend to have more open ground where weeds can get established easier.

Coastal scrub vegetation only becomes a threat to the endangered species habitat when it overtakes important butterfly host and nectar plants within the grasslands. Moderate densities of coastal scrub within the grasslands of San Bruno Mountain provide important resources for the listed butterflies, such as additional nectar sources and perching sites. For these reasons management of coastal scrub succession should be focused on reduction rather than eradication.

Based on observed proportions of coastal scrub and grassland within core (Priority 1) butterfly habitat areas on San Bruno Mountain, a minimum success criterion for control of coastal scrub is established at 70% control within all grasslands on San Bruno Mountain. This includes areas that have succeeded to coastal scrub over the 25-year span of the HCP (i.e., 122 acres), and were identified as areas of concern due to declining trends in butterfly occupancy.

In contrast, invasive species typically not only impact the species of concern but also impact the overall ecosystem through establishment of monocultures. Some of these species however such as Italian thistle (*Carduus pycnocephala*), wild radish (*Raphanus sativus*), and pin-cushion plant (*Scabiosa purpurea)*, are utilized frequently as nectar sources by mission blues and callippes. Due to the invasiveness of these species, and the availability of a wide variety of native plant species as nectar sources for the butterflies, control of these invasive species is conducted. This work needs to be conducted prior to the flowering period of the species to avoid impacts to the endangered butterflies.

A goal of 90% control is established for mature, non-native trees, forbs and herbs. Though complete control of all invasive species is an unlikely probability, focused efforts on the most invasive species threats should be directed toward attaining 90% control or better. Control of invasive species is still the highest priority due to the threats these species pose to the endangered species and the overall ecosystem on San Bruno Mountain.

Table 1. Goals, Objectives and Success Criteria for the Mission Blue, Callippe Silverspot, San Bruno Elfin and Bay Checkerspot Butterflies on San Bruno Mountain.

MISSION BLUE BUTTERFLY BIOLOGICAL GOALS AND OBJECTIVES	
GOAL: 1. Maintain or expand a self-sustaining and viable mission blue population from baseline condition of 1982 (permit year).	
OBJECTIVES:	SUCCESS CRITERIA/PERFORMANCE STANDARDS:
1.1 Maintain a sufficient quantity and quality of conserved habitat for MB on SBM, which supports a viable and stable population of mission blue butterflies over time.	1.1 Objective is met when: a) the amount of grassland on SBM is maintained within a range of 1,200 –1,800 acres, b) Mature, non-native trees, forbs and herbs are 90% controlled[3] and coastal scrub is 70% controlled within all grassland habitats[4], c) grasslands on SBM are consistently providing suitable host and nectar plant habitat for MB, d) grasslands on SBM are comprised of a significant and diverse native plant species component[5]; and e) the relative abundance and/or the distribution of mission blue butterflies show no statistically significant declining trend over time.

[3] The 90% criterion applies to all major invasive species that form monoculture stands that overtake native grassland habitat for the mission blue and callippe silverspot butterflies. These invasive species include woody invasive species such as gorse, French broom, Portuguese broom, Eucalyptus spp., among others, as well as herbaceous invasive species such as poison hemlock, Bermuda buttercup, and cape ivy. Invasive species not subject to the 90% control criteria include invasive grasses such as rattlesnake grass and herbaceous invasive species such as English plantain. These species are less of a threat to the butterflies of concern, and are more difficult to control due to their ubiquitous distribution on San Bruno Mountain. These species are still considered a high priority for control; however their control will depend on the ability of habitat managers to utilize additional tools such as grazing and/or burning on a consistent basis.

[4] The 70% criteria for coastal scrub control within mission blue and callippe silverspot habitat is a mountain-wide criterion, and should be adaptively implemented based on slope exposure, elevation, fog influence, and other factors such as the value of coastal scrub to native and special status species. For example, for south facing grasslands a 90% criterion may be the appropriate objective for control of coastal scrub, whereas for north facing slopes a 50% criterion may be a more appropriate objective.

[5] The significant and diverse plant species component shall be determined through monitoring data, which will establish a target percent cover threshold for native plant species within the grasslands of San Bruno Mountain. This threshold will be determined through analysis of grassland monitoring data collected and analyzed by the Habitat Manager, and reviewed by the TAC.

MISSION BLUE BUTTERFLY BIOLOGICAL GOALS AND OBJECTIVES	
1.2 Apply vegetation management tools (e.g., grazing, burning, and mowing) that imitate natural disturbance processes to sustain and improve the quality of the native grassland habitat.	1.2 Objective is met when it is determined which tools (grazing, burning, and/or mowing) are best used for improving grassland habitat, and these tools are implemented effectively on an annual basis within, at a minimum, the Priority 1 habitat areas.
1.3 Restore MB colonies to areas on SBM where the population has declined due to coastal scrub succession and/or invasive species, and create restoration sites (habitat islands) with MB host and nectar plants where appropriate conditions exist.	1.3 Objective is met when habitat restoration activities successfully restore an estimated amount of habitat that is equal in proportion or greater to the amount of mission blue habitat that has been lost within the Conserved Habitat areas due to invasive species and/or coastal scrub succession over the span of the HCP. Restored areas shall be: a) 90% controlled for mature, non-native trees, forbs and herbs and 70% controlled for coastal scrub; b) have MB host and nectar plants established and maintained at densities that provide high quality mission blue habitat, as specified in the Butterfly Habitat Restoration Guidelines (Appendix B); and c) MB presence has been recorded for 5 consecutive survey years within each restoration site.
1.4 Ensure that the restoration of habitat in graded and developed areas (HCP “temporarily disturbed conserved habitat”) is maintained to established restoration standards prior to acceptance by the Plan Operator.	1.4 Objective is met when areas to be dedicated to the HCP conserved habitat area are: a) 90% controlled for mature, non-native trees, forbs and herbs for a minimum of 5 years; b) 70% controlled of coastal scrub; and c) have established restoration sites that meet the Butterfly Habitat Restoration guidelines (Appendix B).
1.5 Ensure that habitat easements in undisturbed areas (HCP “preserved habitat”) are being sufficiently maintained to provide suitable habitat for mission blue prior to acceptance by the Plan Operator.	1.5 Objective is met when areas to be dedicated as HCP “preserved habitat” are 90% controlled for mature, non-native trees, forbs and herbs and 70% controlled for coastal scrub, and -- if suitable MB habitat is present-- these areas continue to provide suitable habitat for MB.

MISSION BLUE BUTTERFLY BIOLOGICAL GOALS AND OBJECTIVES	
OBJECTIVES:	SUCCESS CRITERIA/PERFORMANCE STANDARDS:
1.6 Maintain data on MB relative abundance and/or distribution of MB on San Bruno Mountain.	1.6 Objective is met when MB butterfly monitoring data allows for year-to-year comparison and detection of trends over time. Monitoring data may utilize presence/absence and/or relative abundance methods for comparison across years. Host and nectar plants shall also be surveyed at MB transects on the same schedule as the butterfly surveys. This will enable managers to monitor the status of MB habitat, and draw correlations between habitat changes and MB numbers.
1.7 Monitor for mission blue butterfly at restoration sites.	1.7 Add proportion of MB restored areas to butterfly monitoring survey scheme and consistently monitor over time.
1.8 Monitor quantity and quality of grassland habitat that supports mission blue butterflies.	1.8 Objective is met when grassland habitat is monitored for species composition, residual dry matter, nitrogen deposition, and/or other parameters[6] that provide a data set for detecting changes over time.

[6] Monitoring parameters shall be determined and established by the Habitat Manager and reviewed by the San Bruno Mountain TAC.

CALLIPPE SILVERSPOT BUTTERFLY BIOLOGICAL GOALS AND OBJECTIVES	
GOAL: 2. Maintain or expand a self-sustaining and viable callippe silverspot population from baseline condition of 1982 (permit year).	
OBJECTIVES:	SUCCESS CRITERIA/PERFORMANCE STANDARDS:
2.1 Maintain a sufficient quantity and quality of conserved habitat for CS on SBM, which supports a viable and stable population of callippe silverspot butterflies over time.	2.1 Objective is met when: a) the amount of grassland on SBM is maintained within a range of 1,200 –1,800 acres; b) mature, non-native trees, forbs and herbs are 90% controlled and coastal scrub is 70% controlled within all grassland habitats; c) grasslands on SBM are consistently providing suitable host and nectar plant habitat for CS; d) grasslands on SBM are comprised of a significant and diverse native plant species component; and e) the relative abundance and/or the distribution of callippe silverspot butterflies show no statistically significant declining trend over time.
2.2 Apply vegetation management tools (e.g., grazing, burning, and mowing) that imitate natural disturbance processes to sustain and improve the quality of the native grassland habitat.	2.2 Objective is met when it is determined which tools (grazing, burning, and/or mowing) are best used for improving grassland habitat, and these tools are implemented effectively on an annual basis within, at a minimum, the Priority 1 habitat areas.
2.3 Restore CS colonies to areas on SBM where the population has declined due to coastal scrub succession and/or invasive species, and create restoration sites with CS host and nectar plants where appropriate conditions exist.	2.3 Objective is met when habitat restoration activities successfully restore an estimated amount of habitat that is equal in proportion or greater to the amount of callippe silverspot habitat that has been lost within the Conserved Habitat areas due to invasive species and/or coastal scrub succession over the span of the HCP. Restored areas shall be: a) 90% controlled for mature, non-native trees, forbs and herbs and 70% controlled for coastal scrub; b) have CS host and nectar plants established and maintained at densities that provide high quality callippe silverspot habitat, as specified in the Butterfly Habitat Restoration Guidelines (Appendix B); and c) CS presence has been recorded for 5 consecutive survey years within each restoration site.

CALLIPPE SILVERSPOT BUTTERFLY BIOLOGICAL GOALS AND OBJECTIVES	
2.4 Ensure that the restoration of habitat in graded and developed areas (HCP "temporarily disturbed conserved habitat") is maintained to established restoration standards prior to acceptance by the Plan Operator.	2.4 Objective is met when areas to be dedicated to the HCP conserved habitat area are: a) 90% controlled for mature, non-native trees, forbs and herbs for a minimum of 5 years; b) 70% controlled of coastal scrub; and c) have established restoration sites that meet the Butterfly Habitat Restoration guidelines (Appendix B).
2.5 Ensure that habitat easements in undisturbed areas (HCP "preserved habitat") are being sufficiently maintained to provide suitable habitat for callippe silverspot prior to acceptance by the Plan Operator.	2.5 Objective is met when areas to be dedicated as HCP "preserved habitat" are 90% controlled for mature, non-native trees, forbs and herbs and 70% controlled for coastal scrub, and --if suitable CS habitat is present-- these areas continue to provide suitable habitat for CS.
2.6 Maintain data on CS relative abundance and/or distribution of CS on San Bruno Mountain.	2.6 Objective is met when CS butterfly monitoring data allows for year-to-year comparison and detection of trends over time. Monitoring data may utilize presence/absence and/or relative abundance methods for comparison across years. Host and nectar plants shall also be surveyed at CS transects on the same schedule as the butterfly surveys. This will enable managers to monitor the status of CS habitat, and draw correlations between habitat changes and CS numbers.
2.7 Monitor for callippe silverspot butterfly at restoration sites.	2.7 Add proportion of CS restored areas to butterfly monitoring survey scheme and consistently monitor over time.
2.8 Monitor quantity and quality of grassland habitat that supports callippe silverspot butterflies.	2.8 Objective is met when grassland habitat is monitored for species composition, residual dry matter, nitrogen deposition, and/or other parameters that provide a data set for detecting changes over time.

SAN BRUNO ELFIN BUTTERFLY BIOLOGICAL GOALS AND OBJECTIVES	
GOAL: 3. Maintain or expand a self-sustaining and viable San Bruno elfin population from baseline condition of 1982 (permit year).	
OBJECTIVES:	SUCCESS CRITERIA/PERFORMANCE STANDARDS:
3.1 Maintain existing quantity and quality of conserved habitat for SBE on SBM.	3.1 Objective is met when the amount of grassland on SBM is maintained within a range of 1,200 –1,800 acres, and invasive species and coastal scrub succession are controlled to the extent that SBE habitat on SBM is providing a consistent level of SBE occupancy over time.
3.2 Apply vegetation management tools (e.g., grazing, burning, mowing) that imitate natural disturbance processes to sustain and improve the quality of the native grassland habitat, and identify and reduce factors that reduce that quality.	3.2 Objective is met when it is determined which tools (grazing, burning, and/or mowing) are best used for specific problems and these tools are implemented effectively on a regular basis.
3.3 Restore SBE colonies to areas on SBM where the population has declined due to natural succession and/or invasive species, and create restoration sites (habitat islands) with SBE host and nectar plants, where appropriate conditions exist.	3.3 SBE host and nectar plants shall be planted at suitable restoration sites at established densities. Plants shall be monitored for survival and replaced if necessary. Site shall be controlled for invasive species and coastal scrub succession. Objective is met when site supports suitable SBE habitat and when SBE presence is recorded for 5 consecutive survey years within each restoration site.
3.4 Maintain data on SBE relative abundance and/or distribution and status of SBE habitat on San Bruno Mountain.	3.4 Host and nectar plants shall be surveyed at SBE points/transects on the same schedule as the SBE larvae surveys. This will enable managers to monitor the status of SBE habitat, and draw correlations between plant resources and SBE numbers.
3.5 Monitor status of restoration sites, and SBE utilization.	3.5 Add restored areas to point survey scheme.

BAY CHECKERSPOT BUTTERFLY BIOLOGICAL GOALS AND OBJECTIVES	
GOAL: 4. Maintain distribution and abundance of bay checkerspot butterfly host and nectar plants so that reintroduction can occur in the future if deemed appropriate by regulating agencies and the Plan Operator.	
OBJECTIVE:	SUCCESS CRITERIA/PERFORMANCE STANDARDS:
4.1 Maintain distribution maps for bay checkerspot host and nectar plants. These maps should be updated at least once every five years.	4.1 Identify and characterize potential bay checkerspot butterfly habitat. Objective is met when maps are kept updated and complete and can be used to track the status of potential habitat.
4.2 Consider the habitat and reproductive requirements of bay checkerspot host plants when planning landscape-wide vegetation management. Apply vegetation management tools (e.g., grazing, burning, mowing) that sustain high quality bay checkerspot habitat and identify and reduce factors that reduce that quality.	4.2 Objective is met when it is determined which tool and/or tools is best used to address the management concerns of bay checkerspot butterfly habitat and these tools are implemented effectively and on a regular basis.

B. Performance Indicators and Adaptive Management

Adaptive Management has been a key strategy in the implementation of the HCP since its inception in 1982. Based on changing conditions, emphasis of the management has shifted from the control of a few highly invasive woody plant species (i.e. gorse, eucalyptus, pampas grass and French broom) to inclusion of over 40 invasive woody, herbaceous and grass weeds. In addition, the butterfly monitoring program has been adapted from a wandering transect design to a fixed transect design based on peer reviews of the program. It is likely that in the future there will be new invasive species that will require management on San Bruno Mountain, new and more effective tools for managing habitat, and perhaps even new species discoveries (and/or reclassifications of existing species) that will add to the list of sensitive species on the Mountain.

A key component of adaptive management involves testing and experimentation. Results of experiments conducted on gorse and eucalyptus in the 1990's led to an effective control program that has significantly reduced the size and rate of spread of these species. To manage invasive species and coastal scrub succession more effectively, habitat management may require utilizing techniques such as cattle grazing that have not been tested and monitored on San Bruno Mountain. Additional funding would be required for both the testing and implementation of such programs. If additional funds can be secured, a portion of these funds will be allocated each year to test, monitor and retest techniques to determine their impact prior to broad scale application. Early testing and evaluation is critical to the long-term success of habitat management.

The spread of new arrivals of invasive species, such as plant and/or insect pests could threaten the endangered species through disruption of their life cycle or the life cycle of their host plants. To deal with changing conditions on San Bruno Mountain due to the introduction of new invasive species, or new information showing a dangerous expansion of existing invasive plants or insect pests, the management program for San Bruno Mountain needs to be adaptable. Based on recommendations from the TAC and the USFWS, and with the approval of the HCP Trust, the Habitat Manager will reprioritize funds and resources to address changing conditions on the Mountain as needed.

Table 2 shows the methods and process of evaluating the effectiveness of management efforts and the adaptive management approach for remedial action when performance indicators are not met.

Table 2. Performance Indicators and Adaptive Management for Monitoring Effectiveness of Habitat Management Plan Objectives

OBJECTIVE	INDICATOR/MEASURED VALUE	MINIMUM VALUE	METHOD FOR ASSESSING STATUS OF MEASURED VALUE	REMEDIAL ACTION TO BE IMPLEMENTED IF MIMIMUM VALUE IS NOT MET
Maintain a sufficient quantity and quality of conserved habitat for listed butterflies on SBM, which supports a viable and stable population of butterflies over time	a) Acreage of grassland	The amount of grassland on SBM is maintained within a range of 1,200 – 1,800 acres	Measure using digital ortho-photos and field correction every 5 years	Reassess and modify invasive species and coastal scrub succession control program
	b) Acreage of invasive species and coastal scrub within grasslands	90% control of mature, non-native trees, forbs and herbs and 70% control of coastal scrub within grassland habitats	Measure using digital ortho-photos and field correction every 5 years	Reassess and modify invasive species and coastal scrub succession control program
	c) Quality of butterfly habitat within grasslands	Grasslands on SBM are consistently providing suitable habitat for butterflies	Monitor distribution of host and nectar plants through GPS mapping or other suitable methods on San Bruno Mountain every 5 years.	Consider options to increase the density of butterfly host and nectar plants, such as outplanting
	d) Percent cover of native plant species within grasslands	Grasslands on SBM are comprised of a significant and diverse native plant species component	Measure with habitat monitoring techniques	Reassess and modify invasive species and coastal scrub succession control program and consider outplanting of native species.
	e) Butterfly abundance and distribution	The relative abundance and/or the distribution of butterflies show no statistically significant declining trend over time	Determined though the butterfly monitoring program	Evaluate potential sources for butterfly decline and base remedial actions on findings
Apply vegetation management tools (e.g., grazing, burning, and mowing) that imitate natural disturbance to sustain and improve the quality of the native grassland habitat	Tool use and efficiency within grassland habitat	Tools are implemented effectively on an annual basis within, at a minimum, the Priority 1 habitat areas.	Measured through monitoring programs established for management tool application projects	Reevaluate and modify management tool application projects

OBJECTIVE	INDICATOR/MEASURED VALUE	MINIMUM VALUE	METHOD FOR ASSESSING STATUS OF MEASURED VALUE	REMEDIAL ACTION TO BE IMPLEMENTED IF MIMIMUM VALUE IS NOT MET
Restore butterfly colonies to areas on SBM where the population has declined due to coastal scrub succession and/or invasive species, and create restoration sites (habitat islands) with butterfly host and nectar plants where appropriate exist	a) Acreage of newly created habitat (either restoration of previously occupied habitat or creation of habitat islands); b) percent cover of invasive species and coastal scrub within these areas; c) percent cover of butterfly host and nectar plants within these areas; and d) butterfly presence within these areas	Restoration of an estimated amount of habitat that is equal in proportion or greater to the amount of butterfly habitat that has been lost within the conserved areas due to invasive species and/or coastal scrub succession over the span of the HCP. Restored areas shall be: a) 90% controlled for mature, non-native trees, forbs and herbs and 70% controlled for coastal scrub; b) have butterfly host and nectar plants installed and maintained at densities that provide high quality butterfly habitat; and c) butterfly presence has been recorded for 5 consecutive survey years within each restoration site.	Measured through GPS mapping, individual plant counts within restoration sites, and butterfly monitoring	Reevaluate and modify butterfly restoration efforts
Ensure that the restoration of habitat in graded and developed areas (HCP "temporarily disturbed conserved habitat") is restored to established restoration standards prior to acceptance by the Plan Operator	Percent cover of invasive species, percent cover of coastal scrub -- and where suitable conditions exist -- presence of mission blue and/or callippe silverspot butterfly habitat	Areas are: a) 90% controlled for mature, non-native trees, forbs and herbs; and b) 70% controlled for coastal scrub for a minimum of 5 years. Where suitable conditions exist, sites should have mission blue and callippe silverspot habitat that meets established restoration guidelines (Appendix B).	Measured through GPS mapping and qualitative assessment of the restoration sites	Increase oversight of restoration work by Plan Operator and extend period prior to acceptance
Ensure that habitat easements in undisturbed areas (HCP "preserved habitat") are being sufficiently maintained to provide suitable habitat for butterflies prior to acceptance by the Plan Operator	Percent cover of invasive species, percent cover of coastal scrub -- and where suitable conditions exist -- presence of mission blue and/or callippe silverspot butterfly habitat	Areas are: a) 90% controlled for mature, non-native trees, forbs and herbs; and b) 70% controlled for coastal scrub for a minimum of 5 years. Where suitable conditions exist, sites should have mission blue and callippe silverspot habitat that meets established restoration guidelines (Appendix B).	Measured through GPS mapping and qualitative assessment of the butterfly habitat	Increase oversight of restoration work by Plan Operator and extend period prior to acceptance

OBJECTIVE	INDICATOR/MEASURED VALUE	MINIMUM VALUE	METHOD FOR ASSESSING STATUS OF MEASURED VALUE	REMEDIAL ACTION TO BE IMPLEMENTED IF MIMIMUM VALUE IS NOT MET
Maintain data on butterfly relative abundance and/or distribution of butterflies on San Bruno Mountain	Butterfly abundance and /or distribution data	Butterfly data is consistently collected, stored, and analyzed, and allows for year-to-year comparison and detection of relative abundance trends over time, and effectively guides management decision-making.	Determined though the butterfly monitoring program. Data needs to be robust enough to detect trends in the butterflies' relative abundance to guide decision making.	Revise data collection methods to allow for desired analysis
Monitor for butterflies at restoration sites	Butterfly abundance and /or distribution data	Butterfly data is consistently collected, stored, and analyzed, and allows for year-to-year comparison and detection of relative abundance trends over time, and effectively guides management decision-making. Add proportion of butterfly restored areas to butterfly monitoring program and consistently monitor over time	Evaluation of butterfly monitoring data through statistical power analysis, and peer review of butterfly monitoring program every five years.	Modify butterfly monitoring design to improve data collection and analysis.
Monitor quantity and quality of grassland habitat that supports butterflies	Habitat quality evaluation techniques and data.	Objective is met when grassland habitat is monitored for species composition, residual dry matter, nitrogen deposition, and/or other parameters that provide a data set for detecting changes over time.	Evaluation of habitat monitoring data through statistical power analysis, and peer review of habitat monitoring program every five years.	Modify habitat monitoring design to improve data collection and analysis.

III. HISTORICAL BACKGROUND

The San Bruno Mountain ecosystem has evolved over time under the influence of grazing animals, fire and humans for thousands of years. Grazing animals, including Pleistocene herbivores no longer present, are likely to have grazed on San Bruno Mountain and had a strong influence over the vegetation composition of native plant communities (Edwards 1992).

Over the previous several thousand years, native grasslands were likely maintained by herds of native grazing animals such as Tule elk (*Cervus elaphus nannodes*), occasional wildfire and intentional burning by Native American Indians. Native Americans are likely to have conducted burning on San Bruno Mountain for centuries and possibly longer, to encourage the growth of forbs harvested for food (Keeley 2002). With the coming of Europeans in the late 1700's and the arrival of domesticated livestock, the Mountain was cleared for ranching and farming and was grazed by cattle. For the next two centuries, domesticated grazing animals had replaced native grazing animals in maintaining grasslands, while fire was still being utilized to clear brush.

In the building booms of the 1940's, 50's and 60's, the periphery of San Bruno Mountain gradually grew into the cities of Brisbane, Daly City, Colma, and South San Francisco. By the 1970's, San Bruno Mountain had become one of the largest open space areas surrounded by urbanization in the United States. Most of this land was privately owned and was planned for development. However through purchases and donations of parkland to the State (400 acres) and the County of San Mateo (1600 acres), and the conservation of 800 acres through the HCP, approximately 80% of San Bruno Mountain was set aside as protected open space by 1982. In addition, the California Department of Fish and Game purchased 91 acres in Owl and Buckeye Canyons, and protected 15 additional acres within this parcel from development[7].

The creation and expansion of the park created large grassland areas that needed to be protected from the expansion of brush and woodland communities. By the late 20th Century however, native grazing animals had been eliminated and the practices of cattle grazing and regular burning on the Mountain had been eliminated or drastically reduced. These practices had maintained much of the lower elevation and eastern slopes of the Mountain as open grasslands. While the disturbance caused by grazing and burning was beneficial in keeping grasslands open, these practices also allowed invasive species to colonize and spread on the Mountain.

The Mountain today contains large areas of native and non-native grasslands, coastal scrub, and oak woodlands (Figure 4). Three federally listed endangered butterflies, the mission blue, callippe silverspot, and San Bruno elfin, and a variety of rare plants are present within the San Bruno Mountain HCP. Though the butterfly species are rare in other parts of their range, these species continue to be locally abundant on San Bruno Mountain. One federally threatened species, the bay checkerspot butterfly, has been extirpated from the Mountain since the mid-1980's. Habitat for this species is limited to a narrow portion of the summit of the Mountain, and is designated as Critical Habitat by the US Fish and Wildlife Service (Figure 9).

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[7] 76 acres within Owl and Buckeye Canyons were protected through the HCP, and the purchase of this property by CDFG protected an additional 15 acres (91 acres total). This land is managed by the HCP Habitat Manager and through volunteer activities by San Bruno Mountain Watch.

Over the past 25 years, management of the Mountain's ecosystem has been focused on the removal of invasive plant species through hand control, mowing, and herbicide, and the major processes that have shaped the flora of San Bruno Mountain –- grazing and fire —are largely absent today. Wildfires are extinguished before burning substantial acreages to protect local communities, resulting in only approximately 20 – 50 acres burned annually. Prescribed burning has been implemented as a management tool only minimally over the span of the HCP due to fire hazard and air pollution concerns. Grazing has been limited to one pilot grazing experiment in 2002/2003 that covered six acres, and grazing has not been implemented on a large scale due to funding constraints, environmental concerns and the lack of grazing infrastructure (water and fencing) on the Mountain.

A. Invasive Species and Brush Succession

Native grassland is vulnerable to invasive species and brush succession due to its low height and competitive disadvantage to faster growing and/or taller grass, herbs, and shrubs. The process of type conversion from grassland to brush and invasive species is not specific to San Bruno Mountain. It has been occurring for decades throughout California and elsewhere (McBride, J., and H. F. Heady 1968; McBride, J. 1974). This process combined with the loss of grasslands to development has resulted in California native grasslands as being identified as one of the 21 most endangered ecosystems in the United States (PIRG, 1997).

While the current management has been successful in controlling invasive species, the elimination of grazing, burning and other forms of disturbance has resulted in an acceleration of coastal scrub succession and a corresponding loss of grasslands.

In 1982, the HCP documented the loss of grassland on the Mountain due to the expansion of invasives and natural succession, and warned of the potential extinction of the rare butterflies if these processes were not controlled.

> "In 1932 in the San Bruno Mountain area, there was more than four times as much grassland as non-grassland; (whereas) in 1981 the proportions are nearly equal." -- Volume One, San Bruno Mountain HCP, 1982.

> "It is clear that existing biological processes, unchecked, will dramatically reduce the area of grassland habitat in the near future so that the dominant aspect of the Mountain will be brush and exotics". --Volume One, San Bruno Mountain HCP, 1982.

In 1932, most of San Bruno Mountain was covered by grassland due to the intensive ranching and farming practices that had been on-going for several decades. These practices had tipped the balance of the ecological communities well towards grassland. However by 1981, this had changed dramatically due to the cessation of grazing and the suppression of fires beginning in the 1960's.

In 1981, the level of grassland prior to HCP-approved development on San Bruno Mountain was 1,740 acres (calculated from HCP Vol. 1, 1982). Of that grassland, 331 acres has been developed as allowed through the HCP. The amount of protected grassland remaining after development within the conservation areas was estimated to be 1,409 acres. The current estimate of grassland (1287 acres as of 2004) within the conserved habitat area on San Bruno Mountain represents a loss of 122 acres (8.6%) of grassland to coastal scrub succession over the span of the HCP.

Much of the focus of vegetation management since the inception of the HCP has been on control of woody and herbaceous weed species through hand, mechanical, and herbicide methods. During the past 25 years, succession of grassland to coastal scrub has occurred in the Reservoir Hill area, the Carter-Martin area, Owl and Buckeye Canyons, the eastern Saddle, and the north-facing slopes above the Brisbane Industrial Park. The lack of any grazing and/or consistent prescribed burning on the Mountain has allowed native coastal scrub to expand and overtake grassland areas, especially on lower elevation north-facing slopes

This loss of grassland indicates that the current vegetation management program needs to be modified to counteract this process. Approximately 5 acres of grassland are converting to coastal scrub per year, and it is anticipated that this process will continue. Over time, this rate would decline as some areas of the Mountain are resilient to coastal scrub succession, (e.g., areas with thin soils on rocky outcrops, ridgelines and very dry exposures on south-facing exposures). However without reintroduction of a disturbance regime that is commensurate with the level of disturbance the native grasslands evolved with, the grasslands are expected to continue to decrease in area.

Coastal scrub vegetation only becomes a threat to butterfly habitat when it reaches a high density and overtakes important butterfly host and nectar plant habitat within the grasslands. Moderate densities of coastal scrub within the grasslands of San Bruno Mountain provide important resources for the listed butterflies, such as additional nectar sources and perching sites. Coastal scrub also provides shade and greater soil moisture retention for host plants (i.e., *Viola pedunculata* and *Sedum spathulifolium*), and may provide protection of adult and larval stages of the butterflies from predators. Coastal scrub also provides important foraging and nesting habitat for a wide range of native wildlife species. For all of these reasons, management of coastal scrub succession should be focused on control rather than eradication of this important plant community.

B. Habitat Conservation Plan Overview

The Habitat Management Plan applies to conserved habitat within the HCP plan area that is part of the San Bruno Mountain State and County Park, including land that has been dedicated and accepted by the County of San Mateo. Lands that are currently under private ownership, but are required to be dedicated to the conservation area and eventually come under County ownership are also subject to this Habitat Management Plan. Figure 2 shows all conserved habitat and developments as of 2007. These acreages are described in Table 3. Acreages shown are approximated and are slightly different than acreages reported in the original HCP, due to the development of more accurate methods of calculation (i.e. GIS) since 1982. Figures 1 and 2 in Appendix C displays city boundaries within the HCP.

Figure 2. Conserved Habitat and Development on San Bruno Mountain as of 2007

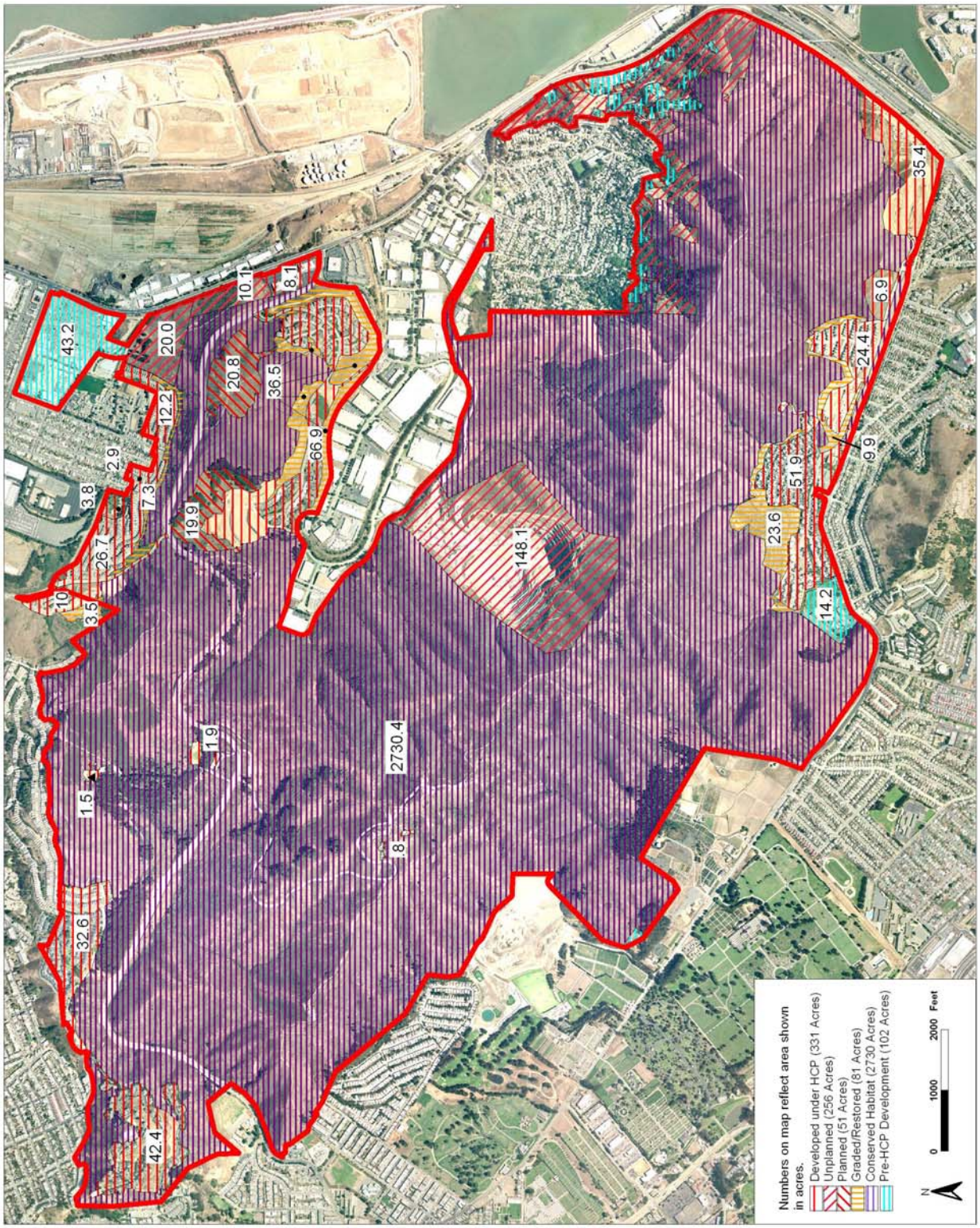


Table 3. Acreages of HCP Conserved Habitat and Development on San Bruno Mountain, September 2007.

Category	Acres	Percentage of HCP Area	Notes
Conserved Habitat	2727	79.1%	Includes lands donated and purchased prior to the HCP, and included in HCP Conservation Area, and Conserved Habitat that is still in dedication process. Total conserved habitat is expected to exceed original HCP calculation of conserved habitat by at least 100 acres due to 1) reduced development plans on the Southeast Ridge and Northeast Ridge, 2) additional lands being purchased for conservation through other land agreements.
Developed Areas	331	9.6%	Includes all areas currently developed as approved through the HCP as of 2007.
Unplanned areas	256	7.4%	Unplanned areas do not have developments or conservation dedications planned at this time (2007). Brisbane Acres was comprised of 154 acres of unplanned parcels in 1982. 42 acres have been purchased as open space by the City of Brisbane through grant assistance, and approximately 16 acres have become planned parcels as of 2007. Conservation of a minimum of 40% of unplanned parcels in Brisbane Acres administrative parcel is required by the HCP. Guadalupe Quarry (148 acres) is an unplanned parcel and is included in the total. Approximately 85 acres of the quarry are disturbed from mining operations, and 73 acres are undisturbed habitat areas located on the east, south, and west. Total reflects subtraction of 42 acres of open space that were purchased by the City of Brisbane, as of 2007.

Category	Acres	Percentage of HCP Area	Notes
Areas temporarily disturbed through grading due to slope stabilization requirements.	81	2.3%	Includes all areas, as of 2007, that have been graded due to temporary disturbance. Most of these areas are required to be restored and dedicated to the HCP conservation Area.
Additional Planned Development Areas	51	1.4%	Pending City, County, and/or USFWS approval. Acreage shown assumes 1989 Approved VTM for the Northeast Ridge included in total. The modified Brookfield homes proposal (2007 VTM) would reduce development by 20 acres in the planned development areas, and these acres would be added to the conservation area.
Total	3,446	99.8%	Total percentage is slightly off due to rounding. Total acres calculated in the 1982 HCP was 3,537. Approximately 100 acres were included in this total that were developed prior to the HCP (Figure 2).

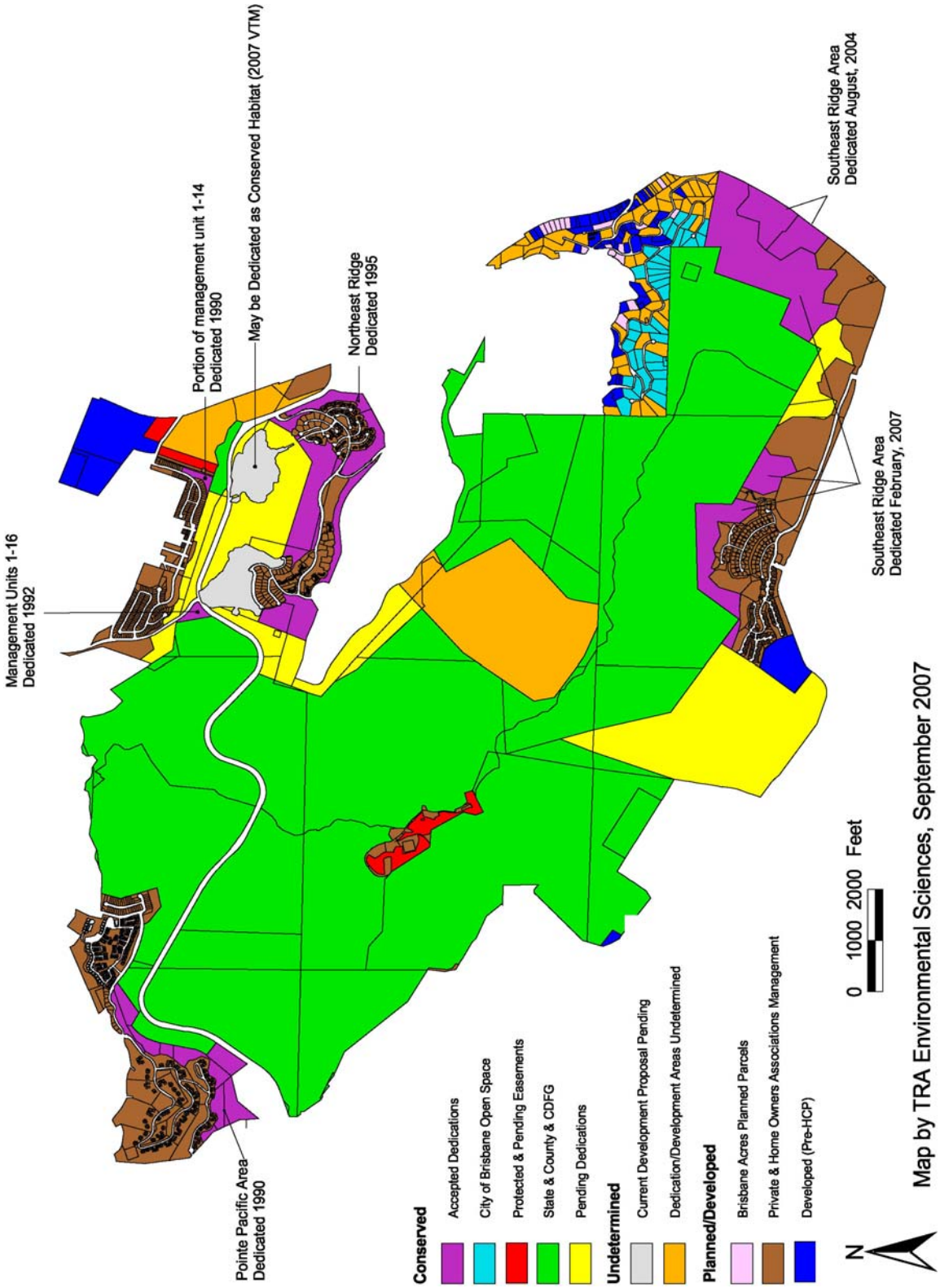
The conservation area consists of lands already dedicated to the park or in the process of dedication. Parcels designated as unplanned do not have development proposals at this time and are subject to habitat conservation requirements of the HCP (TRA, 1982, HCP Vol. II). Figure 3 shows the status of all HCP parcels as of 2007.

Temporarily disturbed lands within the HCP conservation area are subject to the guidelines for restoration of butterfly habitat (Appendix B). The purpose of the restoration guidelines is to aid those conducting restoration in meeting butterfly habitat restoration goals of the HCP. Some slopes disturbed through slope stabilization requirements are located adjacent to the developments are not within the HCP conservation area. These areas are managed by the Homeowners Association of each development.

Conserved areas protected through other mechanisms include areas purchased and managed by City of Brisbane as conserved open space (42 acres), areas purchased by the Trust for Public Land such as the Preservation Parcel on Southeast Ridge (26 acres), and areas purchased by California Department of Fish and Game (15 additional acres conserved).

The 2007 Habitat Management Plan focuses only on the land within the HCP plan area. However control of invasive species would be enhanced by management efforts on both sides of the HCP boundary, and this is critical toward the long-term success of invasive species control on San Bruno Mountain. One example of control efforts being conducted on both sides of the HCP boundary is the northern Saddle area where gorse control is conducted by the Habitat Manager on HCP lands, and the City of Daly City has instituted a mandatory gorse control ordinance on adjacent landowners. The HCP Habitat Manager will need to continue work with adjacent landowners to achieve the desired objectives of the HCP.

Figure 3. San Bruno Mountain HCP Parcels



IV. VEGETATION TYPES, ENDANGERED SPECIES AND THREATS

A. Vegetation Types and Plant Communities

Figure 4 shows a map of the general vegetation types on the Mountain. Within these broad categories are nine native plant communities and three invasive plant communities. Plant communities are assemblages of plant species that occur together in the same area. They are defined by species composition and relative abundance. The vegetative community descriptions generally follow the classification system provided in *A Flora of the San Bruno Mountains* (McClintock et al, 1991) while nomenclature follows the Jepson Manual (Hickman, 1996). A comparison to the more modern and nationally recognized classification presented in Sawyer and Keeler-Wolf's *A Manual of California Vegetation* (MCV), (1995) is also included.

There are a variety of important native plant communities on San Bruno Mountain and within these plant communities there is significant variation in dominant species and overall species composition. Three types of grassland communities provide habitat for the endangered species (Valley Needlegrass Grassland, Coastal Prairie and Non-native Grasslands). Rocky outcrops are included within grassland communities.

Native Plant Communities

1. Valley Needlegrass Grassland

MCV Classification: Purple Needlegrass Series

Purple needlegrass (*Nassella pulchra*) is a dominant or important species in this grassland community. Associated grass species include foothill needlegrass (*Nassella lepida*), California fescue (*Festuca californica*), California melic (*Melica californica*), and blue wildrye (*Elymus glaucus*). Associated wildflower species include coast iris (*Iris longipetala*), soap plant (*Chlorogalum pomeridianum*) and a rare perennial sunflower species, Diablo helianthella (*Helianthella castanea*). These grasslands represent an important component of habitat for the rare butterfly species on the Mountain because of the higher proportion of native host and nectar plants found in them.

2. Coastal Terrace Prairie

MCV Classification: Pacific Reedgrass Series, California Oatgrass Series, Tufted Hairgrass Series

Coastal prairies dominated by Pacific reedgrass (*Calamagrostis nutkaensis*), California oatgrass (*Danthonia californica*), or tufted hairgrass (*Deschampsia caespitosa*) are a limited but integral component of the plan area. Good examples of this community are located on Kamchatcka Point and April Brook. Associated species include bracken fern (*Pteridium aquilinum*), red fescue (*Festuca rubra*), California fescue, and Idaho fescue (*Festuca idahoensis*). These grasslands represent an important component of habitat for the rare butterfly species on the Mountain because of the higher proportion of native host and nectar plants found in and around them.

3. Valley Wild Rye Grassland

MCV Classification: Creeping Ryegrass Series

Creeping ryegrass (*Leymus triticoides*) dominates in riparian grasslands and mesic grassland slopes. Examples of this community include localities on the Northeast Ridge, Southeast Ridge Preservation Parcel and the base of Wax Myrtle Ravine. Associated species include California brome (*Bromus californica*), blue wildrye and annual invasives such as wild oats (*Avena barbata*). This grassland type typically does not support the butterflies of concern because soils are too moist for host plant survival.

4. Coast Live Oak Woodland

MCV Classification: Coast Live Oak Series

Woodland communities dominated by coast live oak (*Quercus agrifolia*) typically occur on steeper, north to east-facing slopes in Buckeye and Owl Canyons and above the City of Brisbane. Associated shrub species include California coffeeberry (*Rhamnus californica*), poison oak (*Toxicodendron diversilobum*), toyon (*Heteromeles arbutifolia*), and California bay (*Umbellularia californica*). The growth-form of these trees is typically low and shrubby due to the maritime influence.

5. Northern Coastal Scrub

MCV Classification: Coyote Brush Series, California Sagebrush Series

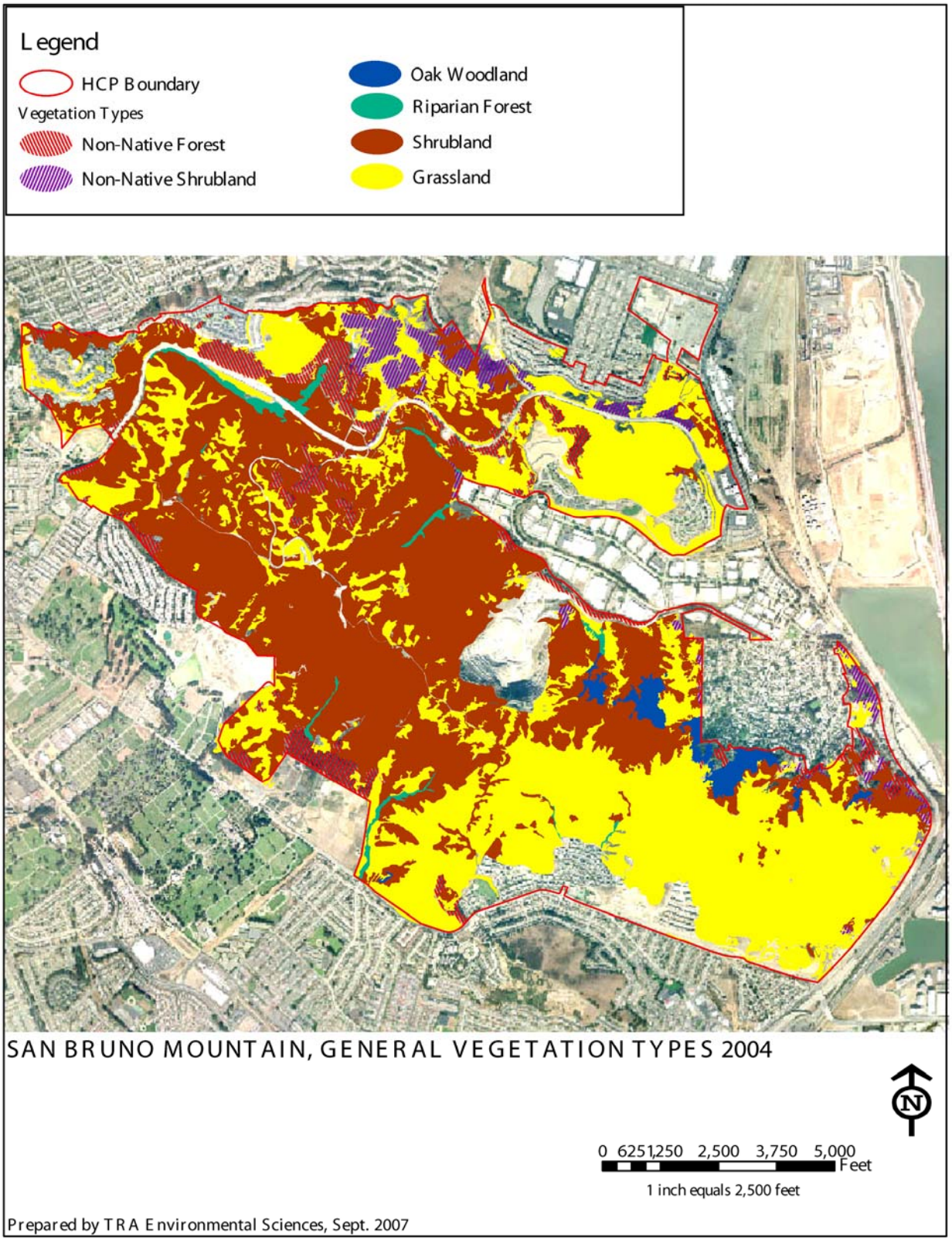
This shrub community is common in many locations on San Bruno Mountain and is dominated by stands of coyote brush (*Baccharis pilularis*) and California sagebrush (*Artemisia californica*). Subdominants include sticky monkeyflower (*Mimulus aurantiacus*) and poison-oak. Associated shrub species include pearly everlasting (*Anaphalis margaritacea*), hazelnut (*Corylus cornuta*), oceanspray (*Holodiscus discolor*), seaside woolly sunflower (*Eriophyllum staechadifolium*) and California blackberry (*Rubus ursinus*).

6. Central Coast Riparian Scrub

MCV Classification: Arroyo Willow Series, Sitka Willow Series

This riparian scrub and forest community occurs along creeks and wet ravines and is dominated by stands of arroyo willow (*Salix lasiolepis*), Sitka willow (*Salix sitchensis*) and California wax myrtle (*Myrica californica*). Associated species include American dogwood (*Cornus sericea* ssp. *sericea*), red elderberry (*Sambucus racemosa*), California blackberry, water parsnip (*Oenanthe sarmentosa*), lady fern (*Athyrium filix-femina*), and cow parsnip (*Heracleum lanatum*).

Figure 4. San Bruno Mountain General Vegetation Types



7. Central Dune Scrub

MCV Classification: Yellow Bush Lupine Series

This dune habitat is only known from the dune habitats west of Pointe Pacific and these habitats are largely outside of the plan area. These sand dune communities are dominated by yellow bush lupine (*Lupinus arboreus*) and blue beach lupine (*Lupinus chamissonis*). Associated plants include sandmat (*Cardionema ramosissimum*), mock heather (*Ericameria ericoides*), evening primrose (*Camissonia strigulosa*, *C. micrantha*) and two rare annual herb species, San Francisco lessingia (*Lessingia germanorum*) and San Francisco spineflower (*Chorizanthe cuspidata* var. *cuspidata*).

8. Blue Blossom Chaparral

MCV Classification: Blue Blossom Series

This shrub community is dominated by blue blossom (*Ceanothus thyrsiflorus*). Associated shrub species include black huckleberry (*Vaccinium ovatum*), coyote brush, toyon, and poison-oak. Large stands of this community occur on the north east-facing slopes below the upper parking lot at the head of the Ridge Trail (Devil's Arroyo). Previous to the last hot fire that occurred in this area in 1964, the north-facing slope below the summit contained only small patches and remnants of blue blossom. A component of this chaparral type includes stands of maritime chaparral dominated by manzanita species such as San Bruno Mountain Manzanita (*Arctostaphylos imbricata imbricata*), Montara Manzanita (*A. montaraensis*), and bearberry (*A. uva-ursi*).

9. Freshwater Marsh & Seeps

MCV Classification: Sedge Series

Wetland marshes and seeps dominated by sedge and/or rush species make up this herbaceous plant community. Dominant rush species include Pacific bog rush (*Juncus effusus*), Baltic rush (*Juncus balticus*), and brown-headed rush (*Juncus phaeocephalus*) while dominant sedge species include slough sedge (*Carex obnupta*), dense sedge (*Carex densa*), and Santa Barbara sedge (*Carex barbarae*). Associated species include fringe cup (*Tellima grandiflora*) and monkeyflower (*Mimulus guttatus*).

Invasive Vegetation Types

10. Broom/Gorse Shrubland

MCV Classification: Broom Series

This community is dominated by non-native legume shrub species such as French broom, gorse, Portuguese broom, and Scotch broom (*Cytisus scoparius*). Though significant portions of infestations of these species have been controlled, there are dense stands of these species remaining on the periphery of the Plan area.

11. Eucalyptus Forest

MCV Classification: Eucalyptus Series

Stands of Eucalyptus (Gum) trees dominate significant portions of the periphery of the plan area. The most prevalent and widespread of the species represented include blue gum and Silver Mountain Gum (*Eucalyptus pulverulenta*). Other non-native trees associated with these communities and occurring elsewhere on the Mountain include Monterey Cypress, acacia (*Acacia* spp.), and Monterey Pine.

12. Non-Native Grasslands

MCV Classification: California Annual Grassland Series, Introduced Perennial Grassland Series

Grasslands dominated by non-native annual or perennial grasslands have become an increasing concern throughout significant portions of the plan area, especially the northeast and southeast ridges. Dominant species include wild oat, ripgut brome (*Bromus diandrus*), velvet grass, Kikiyu grass (*Pennisetum clandestinum*) and Italian ryegrass (*Lolium multiflorum*). Associated non-native forb species are a significant component of this community and dominate the landscape in places. These species include mustards (*Brassica* spp., *Hirschfeldia incana*), wild radish (*Raphanus sativus*), filaree (*Erodium* spp.), sow thistle (*Sonchus oleraceus*), hairy cat's ear (*Hypochaeris radicata*), sheep sorrel (*Rumex acetosella*) and Bermuda buttercup. Though the endangered species are found in non-native grasslands and utilize some non-native species for nectaring, they generally prefer higher quality native grasslands due to the presence of associated native species that are low growing and do not overtake the butterfly host plants.

B. Endangered Butterfly Species

The mission blue, callippe silverspot, and San Bruno elfin butterflies require grassland habitats that support their larval host plants and nectar plants. All three butterflies overlap with one another in distribution, but also are found separately on the Mountain due to the different habitat requirements of their host plants as well as behavioral preferences for different topographic features.

Butterfly habitat on San Bruno Mountain is not static, and the habitat fluctuates both spatially and temporally, within areas where suitable soils and slope exposures are present. Over the course of a single year some habitat areas decline in quality while others increase. For example in the El Nino year of 1998, a significant large-scale decline in habitat quality occurred to mission blue habitat where silver lupine (*Lupinus albifrons var. collinus*) was the dominant host plant species. This resulted in a significant decline in mission blue colonies that utilized silver lupine on San Bruno Mountain (a similar decline occurred to mission blue colonies in the Golden Gate National Recreation Area). In areas on San Bruno Mountain where summer lupine (*Lupinus formosus var. formosus*) plants were the dominant host plant, mission blue observations were not impacted, and may have slightly increased. It is therefore important to provide as much potential habitat as possible to buffer the species from infrequent large-scale declines in habitat quality that occur independent and outside the control of the Habitat Manager.

Within the San Francisco Bay region, San Bruno Mountain provides the largest and most actively conserved and managed habitat area for the callippe silverspot and San Bruno elfin butterflies, and the second largest area for mission blue. Most other sites for each of these

species are either much smaller in size, have less habitat, and/or are not actively managed or monitored on a regular interval. Exceptions to this are Milagra Ridge and Sweeney Ridge in Pacifica and the Marin headlands in the Golden Gate National Recreation Area, where the National Park Service has been monitoring mission blues for several years. Habitat is managed at the Marin headlands (9,600 acres), and Sweeney Ridge (1,200 acres) and monitoring is currently conducted at Milagra Ridge (230 acres). Mission blue butterfly numbers at Milagra are currently stable (Merkle, pers. comm.); however, there are concerns about the long-term viability of this population (Lindzey 2006). Invasive species control is conducted within these sites, but they are not managed for coastal scrub succession at this time (Merkle, pers. comm.).

The callippe silverspot butterfly is found in grassland habitats in the East Bay (Pleasanton Ridge) and the North Bay (Vallejo area), and a Recovery Plan for the callippe silverspot is in process (Longcore, pers. comm.). The San Bruno elfin butterfly is found in a few isolated habitat locations on Milagra Ridge and on Montara Mountain in western San Mateo County. No monitoring information is available for these sites.

Mission Blue

The mission blue butterfly is the most widespread of the endangered butterfly species on the Mountain, and its distribution corresponds closely to the distribution of its host plants. Figure 5 shows a generalized map of mission blue habitat based on grassland extent. (Mission blue host plants have not been mapped on a mountain-wide basis on San Bruno Mountain since 1981; mission blues are limited primarily to areas where their host plants and nectar plants are concentrated. Figure 6 shows the distribution of mission blue and callippe silverspot butterfly observations recorded annually on San Bruno Mountain from 1982 to 2001.

The host plants for the mission blue butterfly are three perennial lupines: silver lupine (*Lupinus albifrons* var*. collinus*), summer lupine *(L. formosus* var*. formosus)*, and varied lupine (*L. variicolor*). Mission blues use a variety of native and nonnative species for nectaring (especially thistles) that are found throughout the grassland and coastal scrub plant communities (Appendix D). Mission blues have been found to move up to approximately 0.25 miles between habitat patches (Thomas Reid Associates, 1981) however the species is likely to move further, during multiple movements between habitat areas. It is unlikely that mission blues are capable of immigrating or emigrating from San Bruno Mountain due to the urbanization barriers surrounding the Mountain.

Protection from wind appears to be an important habitat component for mission blues, and often the species is detected on the leeward side of slopes, or within protected roadcut areas where suitable densities of host plants are present.

Mission blues utilize silver lupine and summer lupine as their primary host plants, and utilize varied color lupine less frequently on San Bruno Mountain. Silver lupine is the most widespread host plant species on the Mountain, and grows within dry habitats such as south and east-facing native and non-native grasslands, roadcuts, rock outcrops, fire breaks, ridgelines, erosion rills, and landslide scars. Summer lupine also grows within disturbed soil conditions, and colonizes roadways and landslide scars that are located in more mesic areas, where soils are typically deeper and/or more sandy. Varied color lupine grows in grasslands and along disturbed roadsides, typically within mesic exposures, and is commonly found within north and west facing grasslands. Varied color lupine tends to be utilized by mission blues when found in large patches and/or plant sizes, or when found in proximity to silver and/or summer lupine plants (perhaps indicating a suitable microclimate is present).

Figure 5. Distribution of Mission Blue Habitat on San Bruno Mountain (Based on Grassland Extent)

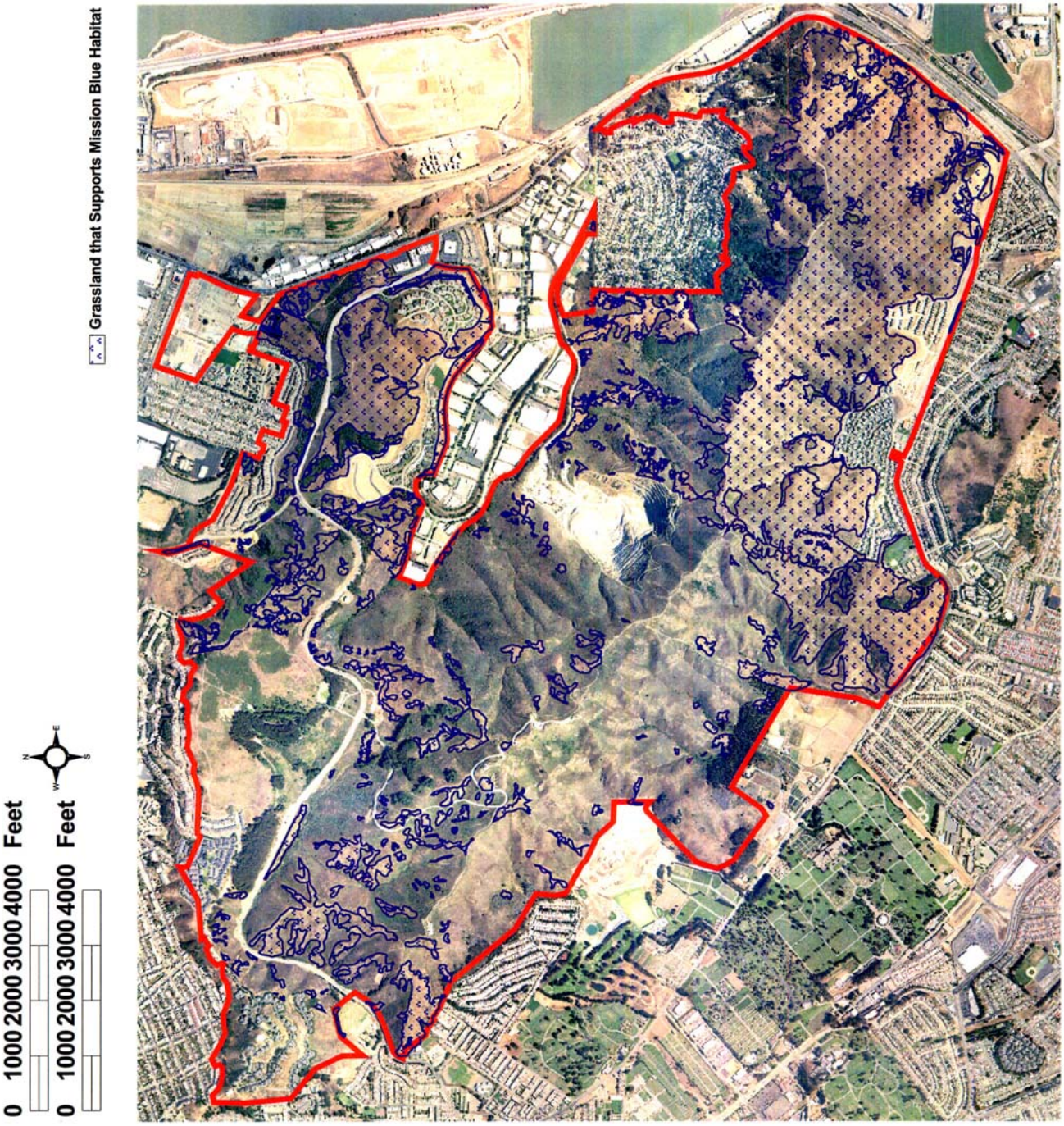
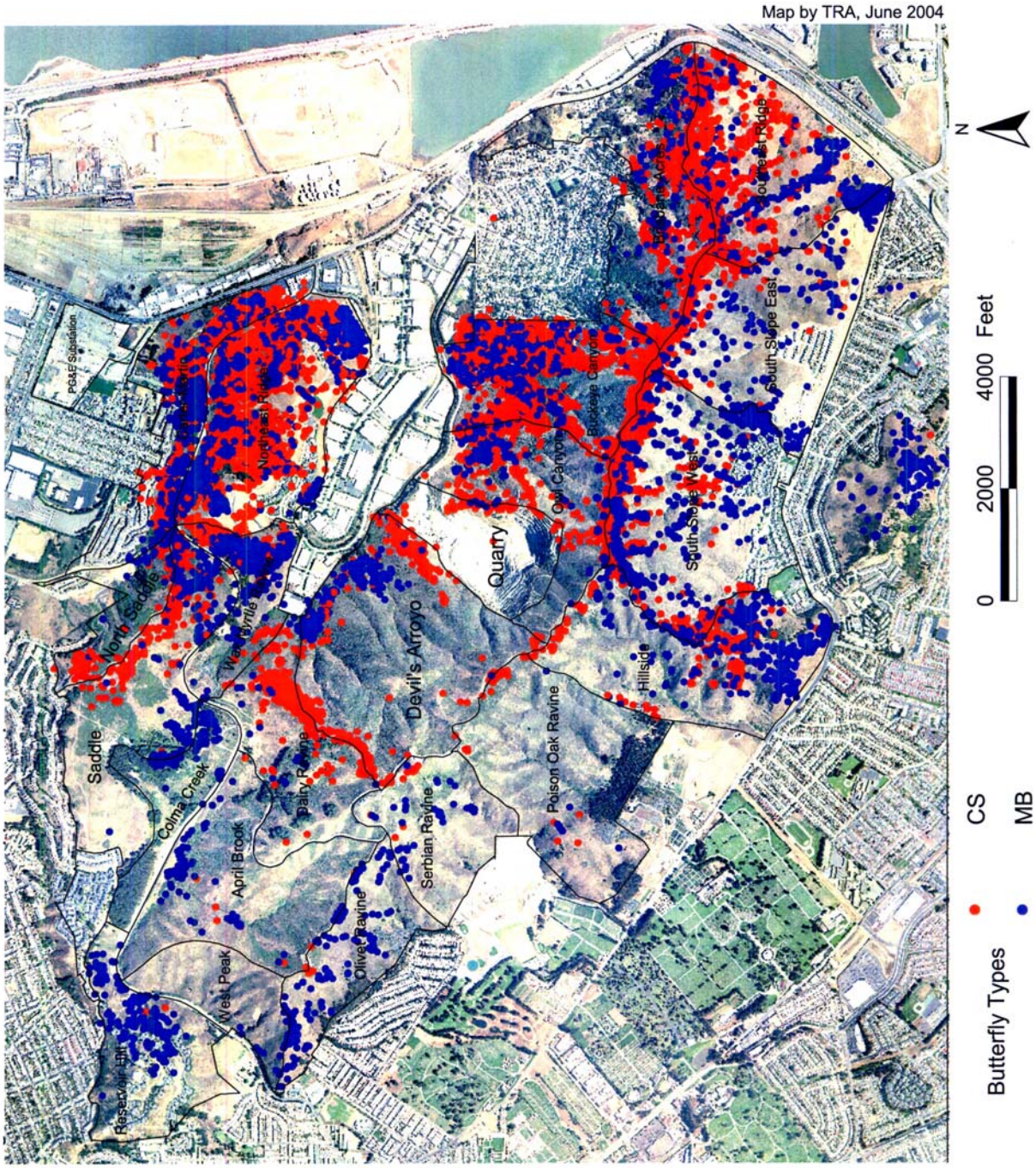


Figure 6. Mission Blue and Callippe Silverspot Distribution on San Bruno Mountain (1982 - 2000)



Callippe Silverspot

The callippe silverspot distribution is similar to that of the mission blue, however the callippe is less frequently observed on the west side of the Mountain (Figures 6). Habitat for the callippe is shown in Figure 7. Viola pedunculata, the host plant for the callippe, is predominately found within mesic to dry open grasslands on both north and south-facing slopes. Viola can also be found on disturbed roadcuts, and along the boundaries between grassland and scrub under partial shade of taller plants. Ridgelines and hilltops within grassland habitats are an important habitat component for this butterfly species, because callippes utilizes these features for mate selection. Callippe silverspots use a variety of native and nonnative species for nectaring (especially thistles) that are found throughout the grassland and coastal scrub plant communities (Appendix D). The species has been shown to move up to approximately 0.75 miles between habitat patches (Thomas Reid Associates, 1981), but likely can move further in multiple movements. Callippe silverspots are capable of immigrating or emigrating from San Bruno Mountain to two adjacent open space areas, Sign Hill and McClaren Park, (both are within 0.25 miles of San Bruno Mountain State and County Park). Both of these parks have extremely limited habitat for callippe at the present time. It is likely that urbanization barriers preclude the callippe from immigrating or emigrating beyond these two adjacent parks.

Due to their larger size and stronger flying ability than mission blues, callippes are not as sensitive to strong winds. Often this species is detected along ridgelines and hilltops in high densities, sometimes during windy conditions (>10 mph average).

San Bruno Elfin

The host plant for the San Bruno elfin butterfly, Pacific stonecrop (*Sedum spathulifolium*), is predominately found in native grassland patches and rocky outcrops, on north-facing slopes above 500 feet elevation. Sedum often grows along transition areas between scrub and grassland. San Bruno elfins use a variety of nectar plants limited to the upper elevation grasslands and scrub on the Mountain (Appendix D). This species has been documented to move at least 0.15 mile between habitat patches (Arnold, 1983), and can likely move much further over the course of multiple flight movements.

San Bruno elfin habitat is located within north-facing grasslands that are highly influenced by summertime fog. Figure 8 shows the distribution of San Bruno elfin habitat on San Bruno Mountain. Coastal scrub plant species are common within San Bruno elfin habitat, and this community type is utilized frequently for nectaring and perching by San Bruno elfins.

Bay Checkerspot

The bay checkerspot butterfly, a federally Threatened butterfly, was observed to be present within a linear band of habitat 0.8 kilometers in length along the summit of San Bruno Mountain up until the mid-1980's. The combination of an extremely small population size, drought, wildfire, and possibly collecting appears to have brought about the extirpation of bay checkerspot butterflies on the Mountain, as no individuals have been observed on San Bruno Mountain since 1984. The host plants for this species, California plantain (*Plantago erecta*) and owl's clover (*Castilleja densiflora*) are still found in relative abundance in coastal prairie and grassland on San Bruno Mountain.

The USFWS designated Critical Habitat for this species on San Bruno Mountain in 2001. The acreage defined by the Service is located on the eastern half of the Mountain, and is located above the 500 foot elevation contour (Figure 9). San Bruno Mountain represents the most

northerly part of the subspecies' former range on the San Francisco peninsula and has reasonably good conditions to support the species. The San Bruno Mountain unit is considered as an essential supporting element of the San Mateo metapopulation, and a backup to the Edgewood and Jasper Ridge populations (USFWS 2001).

Figure 7. Distribution of Callippe Silverspot Habitat on San Bruno Mountain (Based on Grassland Extent)

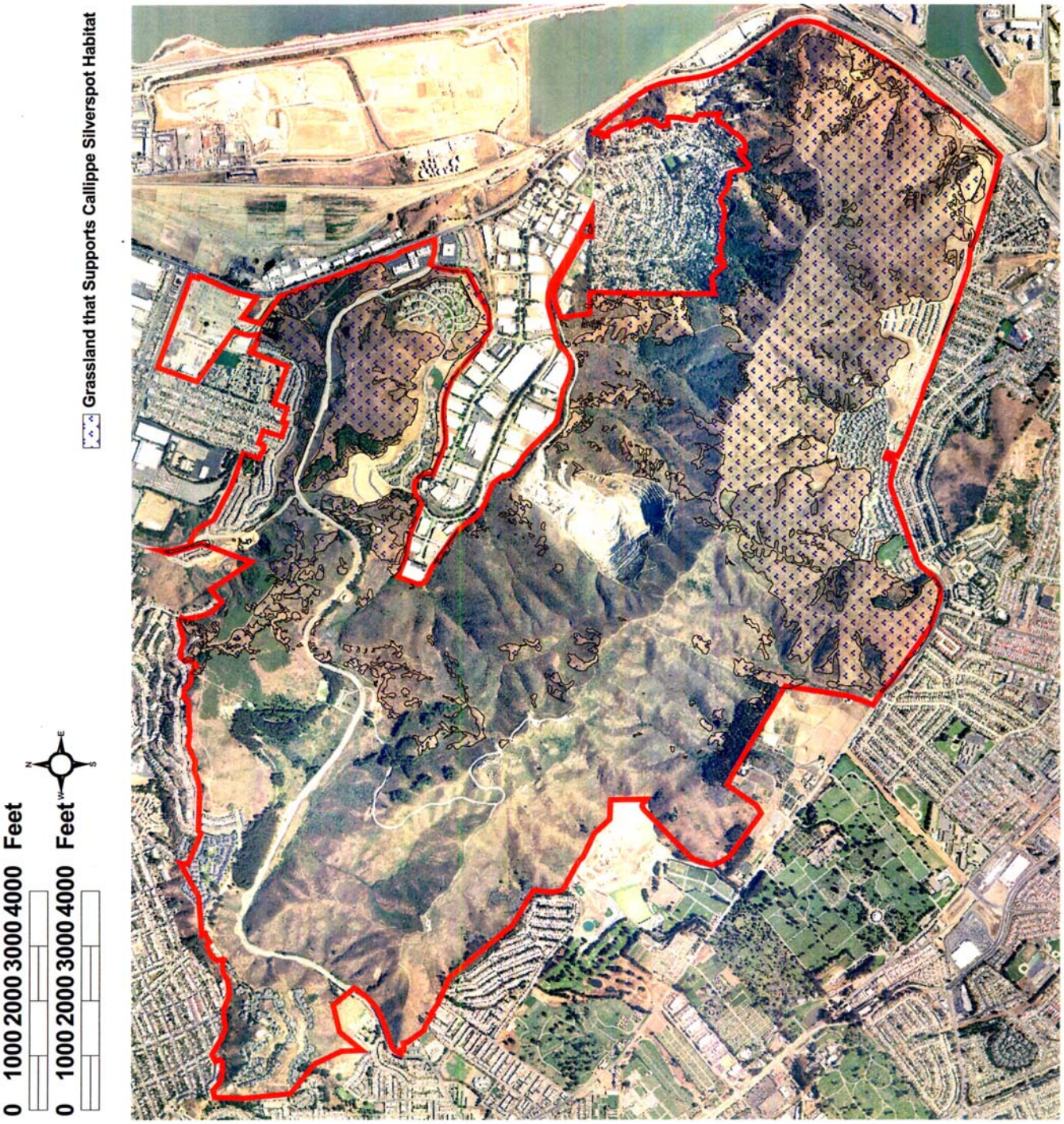


Figure 8. Distribution of the San Bruno Elfin Habitat on San Bruno Mountain

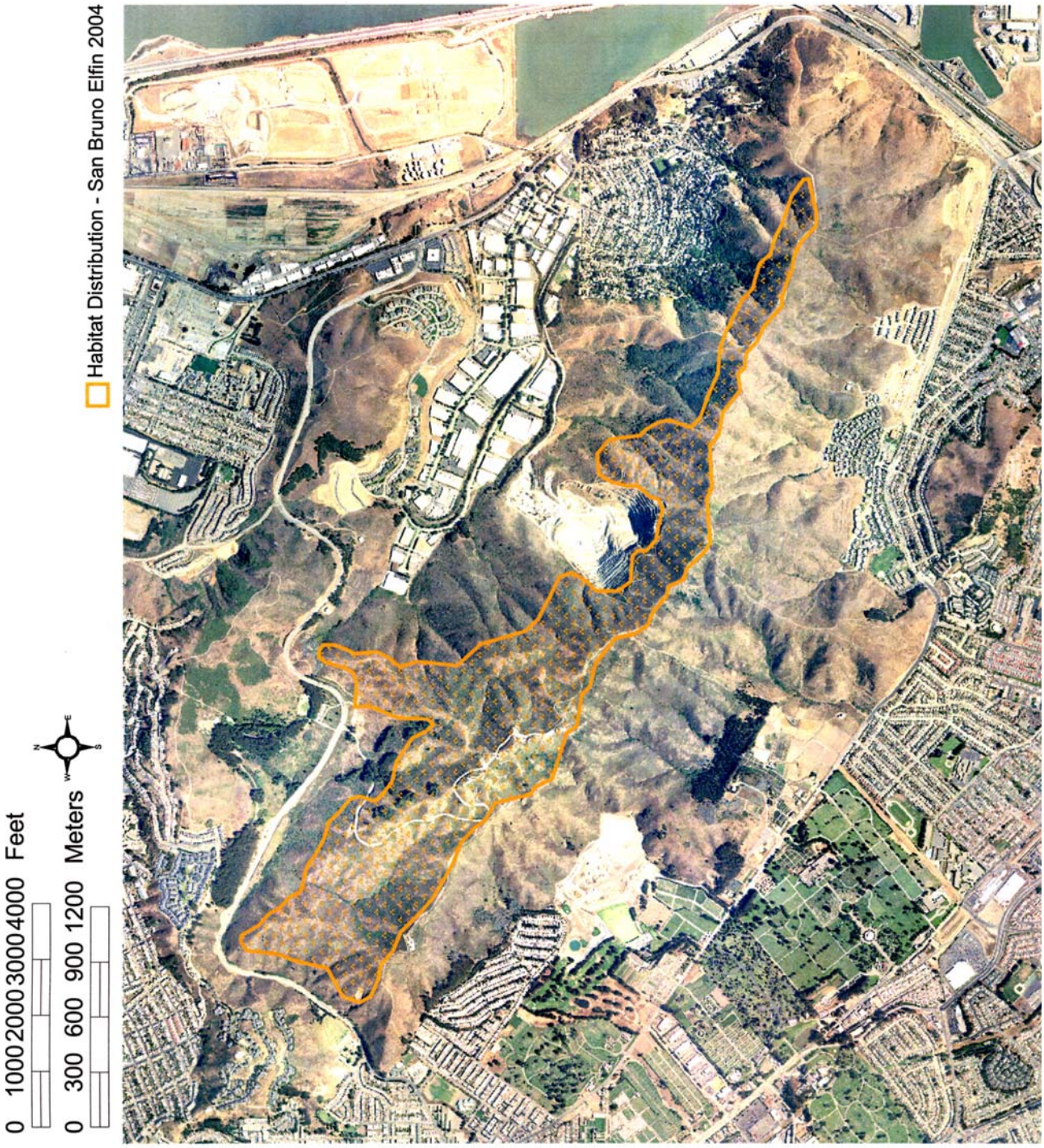
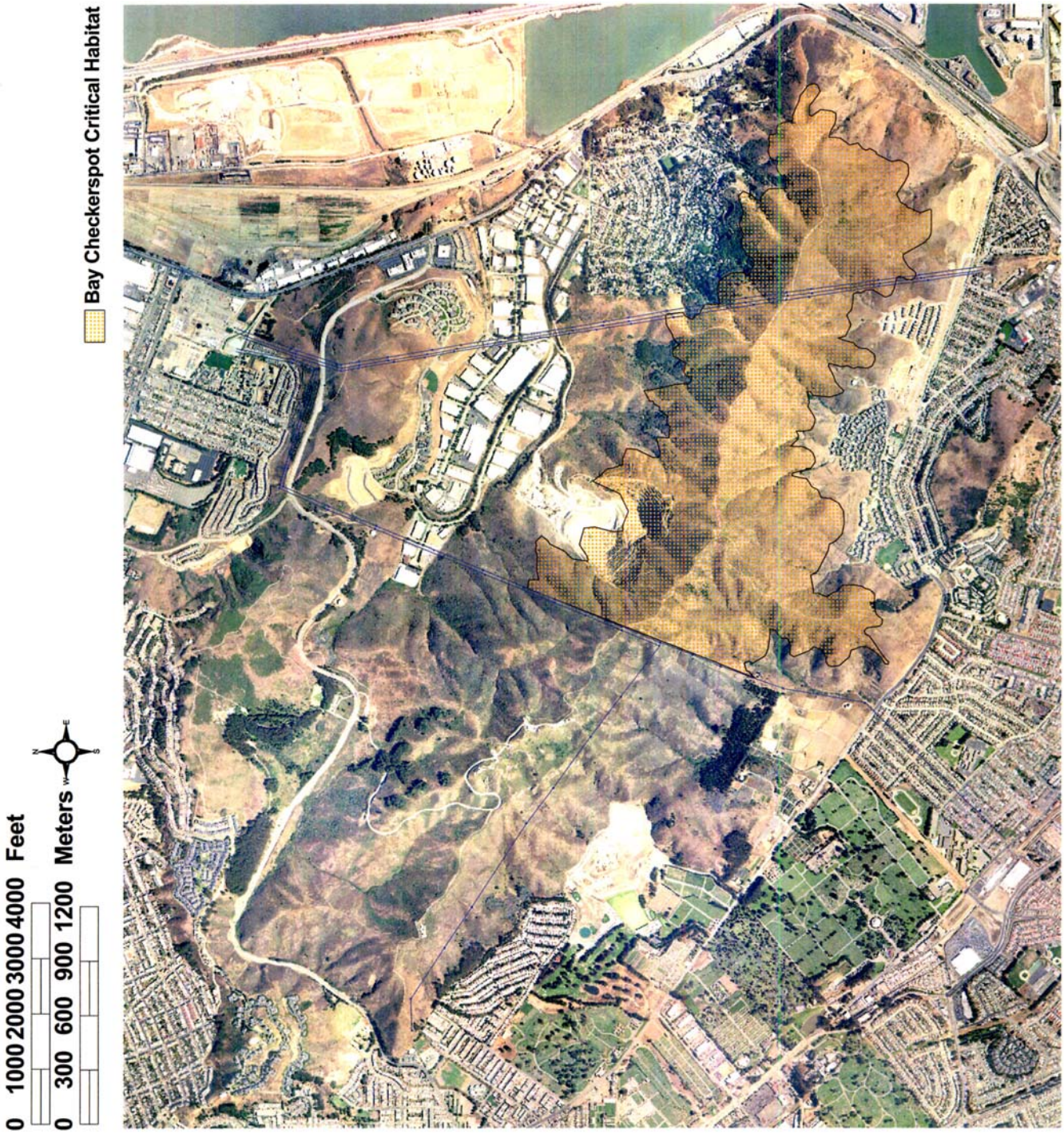


Figure 9. Bay Checkerspot Critical Habitat on San Bruno Mountain



Rare Plants

Rare plant species on San Bruno Mountain include two federal and state endangered species, San Bruno Mountain manzanita (*Arctostaphylos imbricata var. imbricata*) and San Francisco Lessingia (*Lessingia germanorum*), and several California Native Plant Society List 1B species including Montara manzanita (*Arctostaphylos imbricata montaraensis*), Diablo Helianthella (*Helinathella castanea*), San Francisco spineflower (*Chorizanthe cuspidata cuspidata*), and San Francisco campion (*Siliene vercunda verecunda).* For a complete list of rare plant species on San Bruno Mountain see Appendix D. Figures 10, 11, and 12 show the distribution of rare plant species mapped on San Bruno Mountain.

C. Threats to Butterfly Habitat, Rare Plants and Native Plant Communities

Coast Scrub Succession

Portions of Buckeye Canyon, Devil's Arroyo, the Saddle, and other locations (typically north-facing, low elevation slopes) have converted from a mosaic of scrub and grassland to dense coastal scrub over the 25-year span of the HCP. These areas are shown in Figure 1 as brush control areas. In some areas, such as roadside areas along the south side of the Brisbane Industrial Park and the north side of Carter Street in Daly City, a combination of coastal scrub and invasive brush (including gorse, Portuguese broom, and Himalayan blackberry (*Rubus discolor*)) have overtaken grassland areas.

Figure 13 shows an example of brush succession in Buckeye Canyon over the span of the HCP, and Figure 14 shows both butterfly observations and survey routes for mission blue butterfly walked within Buckeye Canyon in the 1980's and again in the 1990's. Habitat in these areas has been overtaken by the expansion of coastal scrub, and the ability to monitor these areas using walking transects has been reduced or eliminated due to the high density of brush.

Coastal scrub can easily overtake grasslands, and the habitat they support for the endangered butterflies, due to the low-growing status of the butterflies' host and nectar plants. All three endangered butterflies also utilize nectar plants within coastal scrub, and utilize shrubs for perching. For this reason, the goal of management should be to control coastal scrub rather than eradicate this plant community.

Under current funding, vegetation management is primarily restricted to invasive species control. Control of coastal scrub has not been adequately addressed, and without a significant increase in funding, it is presumable that additional acres of grassland will be lost to natural scrub succession. Increase funding would allow for the reintroduction of a disturbance regime that is commensurate with the level of disturbance the native grasslands evolved with and which would manage scrub succession.

Figure 10. Distribution of Rare Manzanitas on San Bruno Mountain, 2002

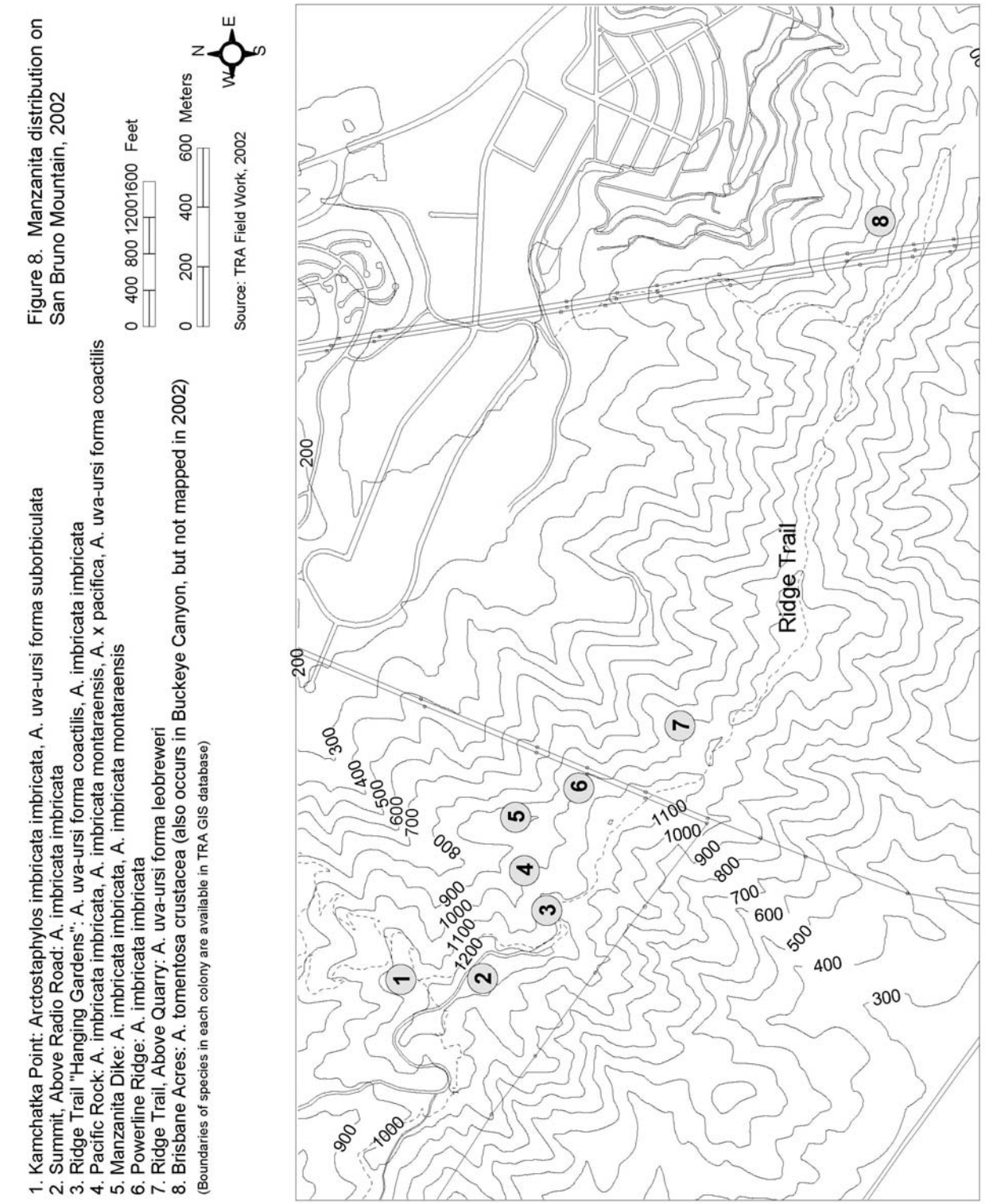


Figure 11. Distribution of Helianthella Castenea and Silene Verecunda on San Bruno Mountain, 2001

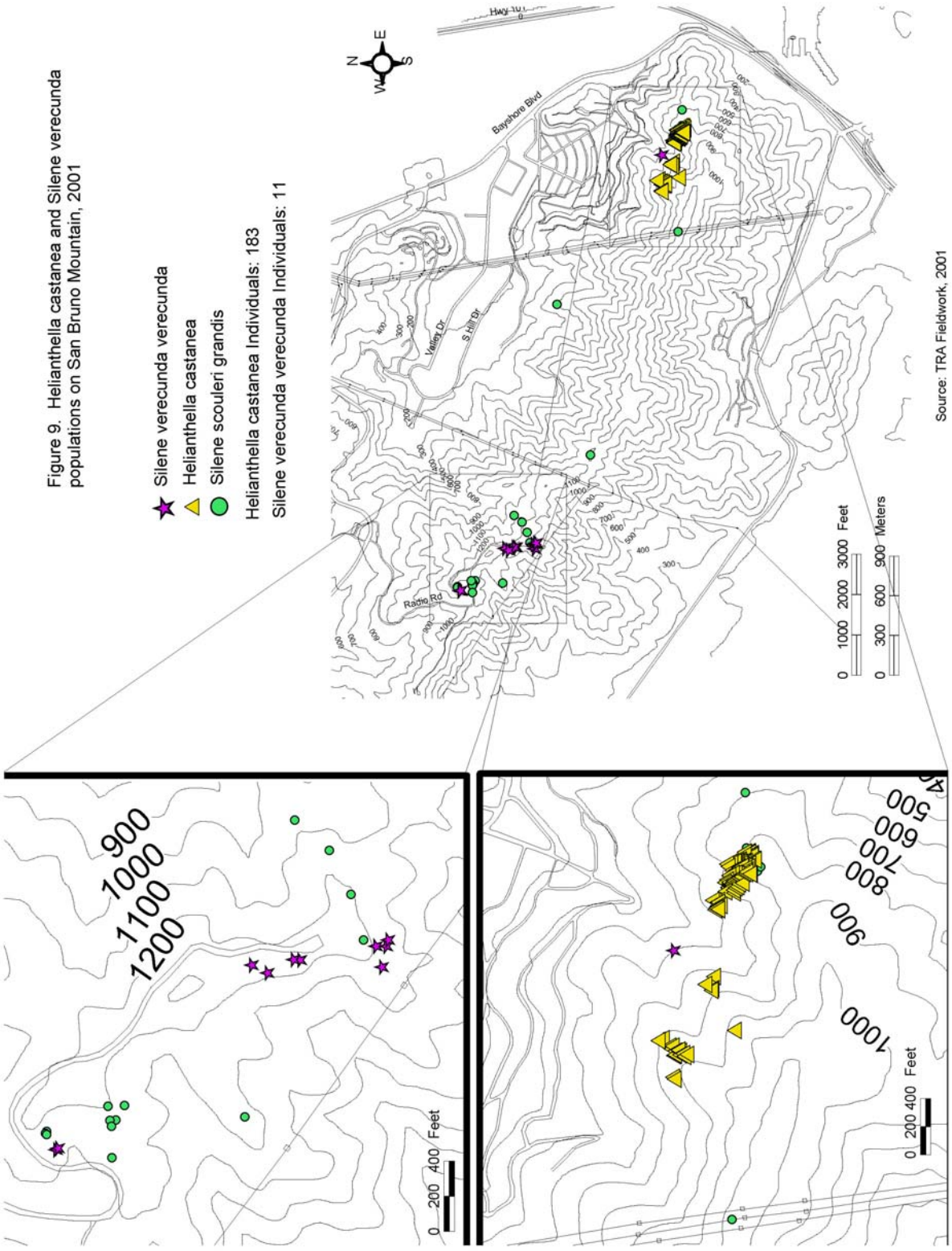


Figure 12. Distribution of Lessingia Germanorum on San Bruno Mountain, 2003

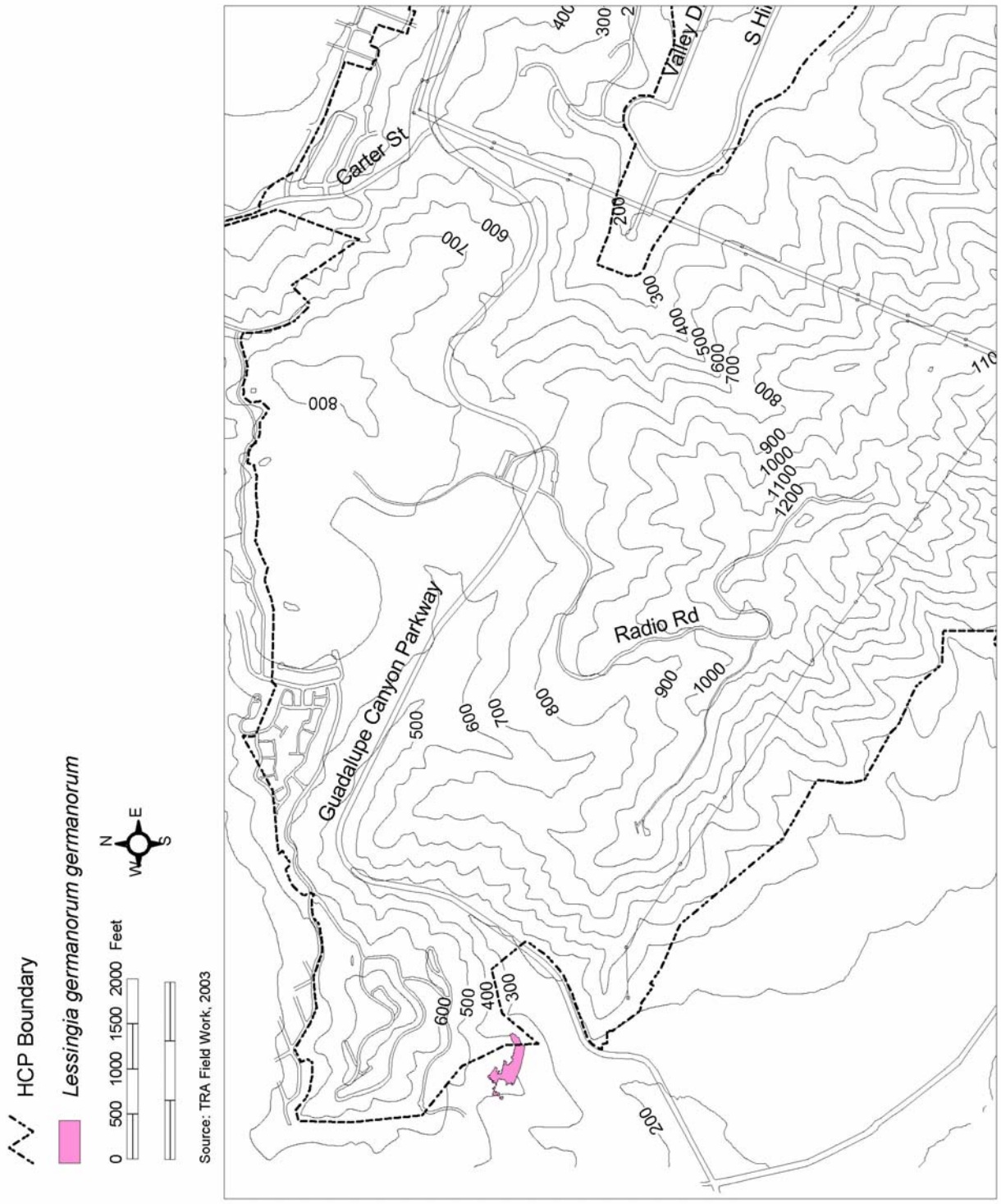
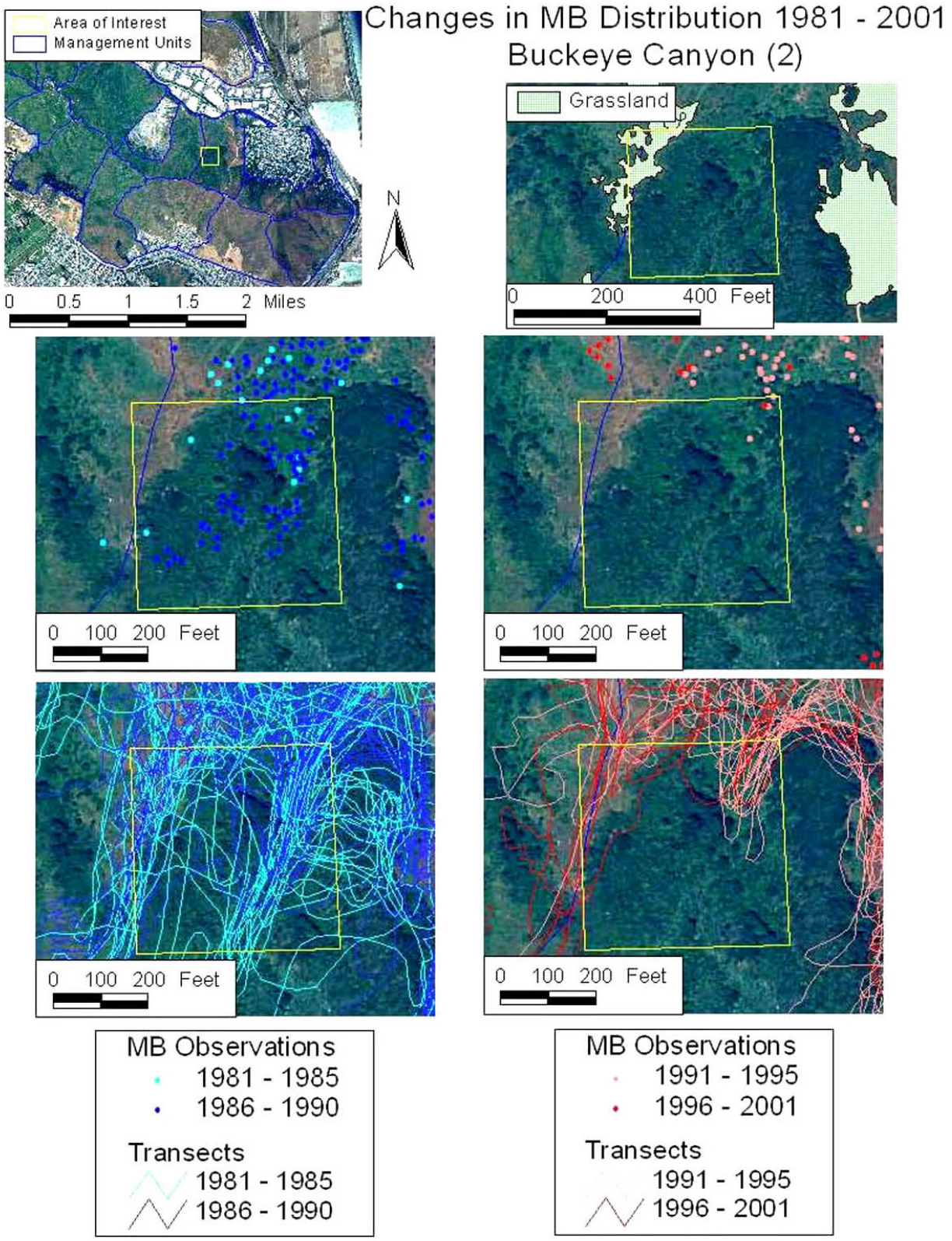


Figure 13. View of Buckeye Canyon and Transmission Line Ridge in 1982 (below), and 2006 (above)

Figure 14. Changes in Mission Blue Distribution



Invasive Plant Species

Figure 15 shows the distribution of invasive plant species on San Bruno Mountain as mapped in 2004. Infestations were mapped using a combination of GPS data and hand drawn polygons on topographic maps in the field. No differentiation was made between high and low density infestations. Due to time and seasonal constraints, not all herbaceous weed infestations were mapped, and invasive grasses were not mapped. A re-mapping of the invasive species on San Bruno Mountain should be conducted on a 5-year rotation.

Invasive species typically not only impact the species of concern but also impact the overall ecosystem through establishment of monocultures, and therefore control and eradication of invasive species should be pursued whenever feasible. In most cases, invasive plant species provide few resources for native wildlife species. Exceptions to this are species such as Italian thistle (*Carduus pycnocephala*), wild radish (*Raphanus sativa*), and pin-cushion plant (*Scabiosa purpurea)*, which are utilized as nectar sources by the endangered species. Due to the invasive habitat of these species, and the availability of native plant species as nectar sources, control of these invasives is conducted.

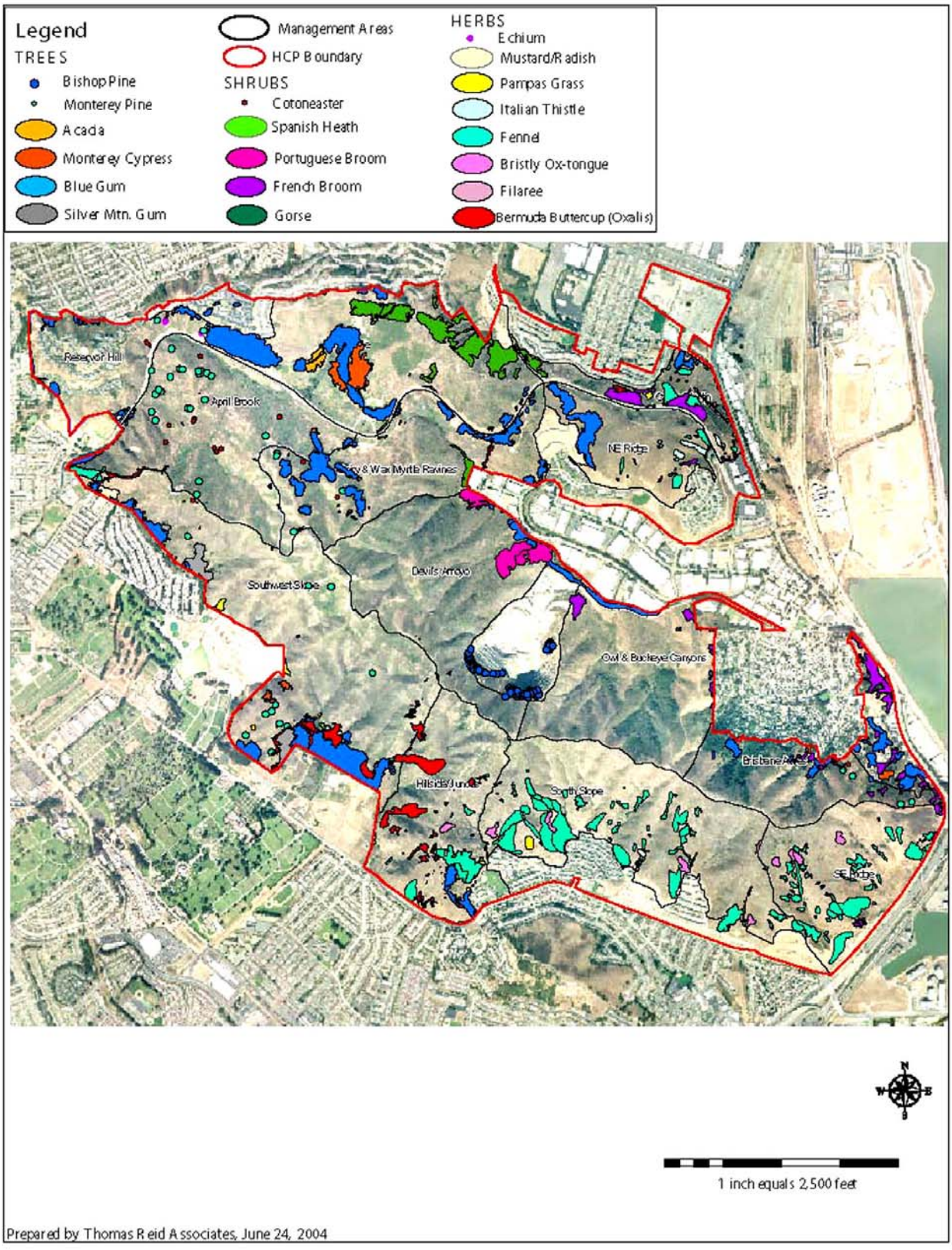
Nitrogen Deposition

Research by Stuart Weiss within serpentine grasslands in the San Francisco Bay Area suggests that anthropomorphic sources of nitrogen are accelerating weed invasions into grasslands (Weiss, S.B. 1999), and this process is potentially accelerating weed invasions and coastal scrub succession on San Bruno Mountain (personal communication, Stuart Weiss). Excess nitrogen in the form of NH4 and NHO3 has been documented as a potential problem throughout California, and especially within urban centers such as Los Angeles, San Diego and the San Francisco Bay Area (Weiss, S.B. 2006). Excess nitrogen deposition within grasslands in the San Francisco Bay Area has been documented at the Kirby Canyon Land Trust in Santa Clara County, and at Edgewood County Park in San Mateo County, approximately 20 miles south of San Bruno Mountain. This phenomenon has also been identified in other urban/parkland grassland ecosystems, such as within the coastal sage scrub habitat of the federally endangered Palos Verdes blue (*Glaucopsyche lygdamus palosverdesensis*) in San Pedro, California (Soil Ecology and Restoration Group, 2004).

Nitrogen that gets deposited on native grasslands behaves like a fertilizer. The more nutrient rich soil is exploited by nonnative weeds, which out-compete the native grasses and herbaceous plants that are adapted to low nutrient conditions. This phenomenon has been well documented in serpentine plant communities which are low in nutrients. Similarly, the ultramafic soils of San Bruno Mountain are also low in nutrients, and the impact from nitrogen deposition is potentially significant.

At Kirby Canyon, cattle grazing has been used effectively to counteract the additional biomass produced through excess nitrogen deposition, and has successfully maintained native grasslands and protected habitat of the federally threatened bay checkerspot butterfly for over 20 years (Peterson, Weiss pers. comm.). Edgewood County Park in San Mateo County has recently begun to use mowing to reduce the biomass of invasive grasses fueled by nitrogen deposition (Ishimaru, ABC-7 News, April 5, 2007). Both of these sites provide critical habitat for the federally threatened bay checkerspot butterfly.

Figure 15. Invasive Plant Species on San Bruno Mountain, 2004



Preliminary estimates based on wind patterns and distance to source areas suggest that approximately 7 KG/ hectare (approximately 6 lbs/acre) of nitrogen are deposited on the slopes of San Bruno Mountain per year (Weiss, pers. comm.). This amount of nitrogen is substantial and would alter vegetation composition over time (Weiss, pers. comm.).

San Bruno Mountain is situated between two highly traveled freeways (Highways 101 and 280), and has extensive urbanization and roads surrounding the park. Prevailing wind patterns and subsequent areas of fog collection on San Bruno Mountain may result in increased nitrogen deposition, as fog may pick up nitrogen (in the form of NH3) as it drifts over Highway 280, before reaching San Bruno Mountain (Weiss. pers. comm.). It is therefore plausible that nitrogen deposition is occurring on San Bruno Mountain, and perhaps at levels that are accelerating invasive species infestations.

Global Warming

Climate models for Northern and Central California suggest that the region will become warmer and possibly wetter, with greater temperature extremes, due to the effects of global warming. This may result in a continuing and accelerated transition from grassland and savannah habitats to forests in the next 70 years (The Wildlife Society, 2004). It is therefore likely that coastal scrub will continue and possibly increase its rate of expansion on San Bruno Mountain if it is not managed. This expansion will predominately occur on north-facing slopes, steep shaded ravines, and on gradual slopes with deeper soils. Steep slopes with thin, rocky soils, and dry south and east-facing slopes are much more resistant to coastal scrub expansion, and these areas are likely to remain grassland despite a warmer and wetter microclimate. Global warming could potentially increase the spread of both native and invasive species that favor warmer and wetter conditions.

Invasive Insect Species

Insect pests that have emerged as a potential problem on San Bruno Mountain include the tussock moth (*Orgyia vetustaz*), and the argentine ant (*Linepithema humile)*. The tussock moth has become naturalized in California, and is commonly found in local native habitats. The tussock moth infested and damaged two San Bruno Mountain Manzanita colonies in 1998. No new infestations or damage caused by the Tussock moth have been identified since the 1998 event.

The Argentine ant (*Linepithema humile*) is a non-native ant that has proliferated in California, especially in wet areas and near human occupation. Argentine ants have been known to decimate native ant populations through competition and aggressive behavior. This may be a concern for mission blue and San Bruno elfin butterflies, which are believed to be facultative myrmecophiles. The butterfly larvae secrete a honeydew substance from an abdominal gland on which the native ants feed. In return, the ants tend to the larvae by helping to protect them from predators and parasites.

California has been infested by numerous colonies of genetically distinct Argentine ants during the last 100 years (Stanford University, 2004). In February 2006, a preliminary study by Jessica Shors, a graduate student at Stanford University, revealed that Argentine ants are present within some of the MB habitat on San Bruno Mountain Information at this time does not suggest that the Argentine ant is a dangerous threat to the sensitive butterflies and their habitat however new information may arise that suggests otherwise. Further study on the possibility that the

Argentine ant could impact native ant species, and potentially disrupt the relationship between mission blue and San Bruno elfin butterflies and native ant species should be investigated.

Loss of Pollinator Species Diversity

See discussion on Bumblebee species in Section VIII.

Potential for Genetic Inbreeding Depression of the Butterfly Populations

It is highly unlikely that mission blues, callippe silverspots, and San Bruno elfins are capable of successfully immigrating to San Bruno Mountain or emigrating to other populations located outside of the Mountain due to significant urbanization barriers surrounding the Mountain. Over time, the San Bruno Mountain butterfly populations could develop reduced viability through genetic isolation, and genetic exchange between other populations of the listed butterflies and San Bruno Mountain should be considered.

Most other protected habitat areas for the listed butterflies are significantly smaller is size than the conserved habitat on San Bruno Mountain (e.g., Twin Peaks and Milagra Ridge for mission blue; Montara Mountain and Milagra Ridge for San Bruno elfin; and Pleasanton Ridge for callippe silverspot). Movement of female butterflies between these locales and San Bruno Mountain may be necessary to insure genetic health of the populations on San Bruno Mountain, and may be vital for the health of these smaller populations. (See section V.B for discussion on genetic exchange program).

V. HABITAT MANAGEMENT METHODS

A. Habitat Management and Restoration Techniques

To preserve, enhance and restore grassland habitat a number of techniques can be utilized either alone or in combination. Techniques are used that can reduce and control invasive plant infestations and brush, reduce thatch and dense annual grasses, and restore native plant communities. Techniques described include hand removal, herbicide application, pile burning, prescribed burning (when permissible), grazing, mechanical clearing, mowing, mycorrhizal inoculation, nutrient fixation, seeding, and planting. The sequence and timing of implementation of these management tools is critical to the success of grassland habitat protection and restoration. To date (2007), the habitat management methods utilized on San Bruno Mountain have been primarily herbicide treatment, mowing, hand removal and replanting (Table 4).

Adaptive Management has been a key strategy in the implementation of the HCP since its inception in 1982. Based on changing conditions, emphasis of the management has shifted from the control of a few highly invasive woody plant species (i.e. gorse, eucalyptus, pampas grass and French broom) in 1982, to inclusion of over 40 invasive woody, herbaceous and grass weeds as of 2007. This adaptive management strategy is integral toward insuring protection of the endangered species habitat on San Bruno Mountain.

For the control of invasive species, a strategy of control and containment is recommended based on the effectiveness of this strategy in the past. Complete eradication of many invasive species is not a practical reality, as invasive species have become well entrenched within the grassland plant community over the past several decades or more. Focusing a substantial amount of resources on the complete eradication of a few invasive species is likely to allow other invasive species to spread. West Coast Wildlands developed an invasive priority plant list to serve as a guide in weed control efforts on the Mountain (Appendix E).

The continued dominance of native grasslands in Brisbane Acres, April Brook, and the ridgelines and upper slopes along the summit from Radio Road to Owl and Buckeye Canyons, indicates that native perennial grasses on north-facing, moderate to steep slopes are more resistant to weed infestations than dryer, south and east-facing slopes on the Mountain (Guadalupe Hills and the South Slope grasslands). For this reason, management of grasslands needs to be adaptive and utilize techniques that are specific to the particular management needs of the area. Management methods need to be consistent in some respects, such as when controlling weed invasions (either through grazing, mowing, or other methods), by treating weeds prior to seed set. In addition, restoration should utilize over-seeding of native species where non-native species have a competitive advantage (Noxious Weed IVM Guide, undated).

Habitat Management Impact Minimization Measures

Habitat management work is conducted to provide long-term beneficial impacts to the special status species as well as other wildlife on the Mountain. However there is potential for short-term impacts to the endangered species and birds and other wildlife that use habitat areas where treatments are proposed. Significant impacts to special status species and populations of common wildlife species are regulated through the California Environmental Quality Act (CEQA). Nesting birds are protected under the Migratory Bird Treaty Act and California Department of Fish and Game Code, both of which prohibit disruption of nests during the nesting season.

A wide variety of bird species nest within the brush and woodland communities on San Bruno Mountain. Common nesting birds include spotted towhee (*Pipilo maculatus*), bushtit (*Psaltriparus minimus*), white-crowned sparrow (*Zonotrichia leucophrys*), chestnut backed chickadee (*Poecile rufescens*) and many others. Special status bird species such as salt marsh common yellowthroat (*Geothlypis trichas sinuosa*), yellow warbler (*Dendroica petechia*), loggerhead shrike (*Lanius ludovicianus*), white-tailed kite (*Elanus leucurus*), northern harrier (*Circus cyaneus*), cooper's hawk (*Accipiter cooperi*) and sharp shinned hawk (*Accipiter striatus*) are also known to occur on San Bruno Mountain.

The following impact minimization measures are required:

1) For all projects:

a) if any nests are detected within a project area, a no activity buffer zone will be delineated around the nest (CDFG typically recommends a 50-foot radius buffer zone around active songbird nests and a 250-foot buffer zone around active raptor nests). No habitat management activities can be performed within the buffer zones during the bird nesting season (February 1 to September 1), or until the nest is determined to be no longer active.

2) For herbicide and hand control projects that are conducted year-round:

a) The habitat management supervisor should conduct pre-project surveys for nesting birds and other wildlife prior to commencing herbicide and/or hand control work. The habitat management supervisor must be competent in identifying signs of wildlife usage (nests, dens, etc.).

b) For projects near drainages, work should be scheduled for the dry season (June to August) to the greatest extent possible, to minimize any potential impact to aquatic areas. A 20-foot buffer zone on both sides of drainages is currently required for non-aquatic approved herbicides (Forbert, pers. comm).

c) Invasive species control work targeting species utilized as nectar plants by the mission blue, callippe silverspot butterflies, and/or San Bruno elfin butterflies should be treated prior to the flowering time of the invasive species to prevent impacts to nectaring butterflies.

3) For brush and/or tree clearing projects (using mechanical methods, goat grazing, prescribed burning or other methods):

a) Projects should be limited to the fall and/or winter months (September 1 to February 1), unless pre-project surveys for nesting birds are conducted and impacts to nesting birds are determined to be insignificant.

b) Tree and woodland removal projects should have pre-project assessments for roosting bat species.

c) Project activities should not be conducted within a 100-foot buffer zone on both sides of drainages unless these activities are deemed necessary to remove an invasive species, protect a listed species, and/or have soil and slope aspects that provide suitable conditions for grassland restoration within the buffer zone. Appropriate erosion control measures will be implemented for these exceptions. This will provide additional protection to species that nest near drainages, and minimize the potential for erosion and sedimentation pollution.

Table 4. Major Invasive Pest Plants on San Bruno Mountain and Current Hand/Herbicide/ or Mowing Treatment Methods for Each (2007).

Invasive Pest Plant Species	Area[8] (acres)	Treatment
Blue Gum *Eucalyptus spp.*	148	After trees are cut, stumps are cut as low to the ground as practical and sprayed with 25% Garlon 4 herbicide
Fennel *Foeniculum vulgare*	90	Fennel is controlled by hand methods or with a 2% Garlon 4 herbicide. The plants are treated by basal foliar spray during the months of April and May prior to seed formation.
Gorse *Ulex europaeus*	34	Gorse is treated, by foliar spraying, year round with 2% Garlon 4 herbicide. Hand removal of seedlings is done when the population is greatly reduced.
French Broom *Genista monspessulana*	28	French broom is controlled with a 2% Roundup Pro (Glyphosate) herbicide throughout the year and with 2% Garlon 4 when fruiting perennial grasses are present. Hand removal of seedlings is done when the population is greatly reduced
Bermuda Buttercup *Oxalis pes-caprae*	25	Bermuda buttercup is controlled with a foliar application of 2% Galon 4/Roundup Pro mixture when a monoculture is present and 2% Garlon 4 when the infestation is intermixed with perennial grasses.
Striatus Broom *Cytisus striatus*	15	Striatus broom is controlled with a 2% Garlon 4 herbicide. The plants are treated, by foliar spraying, year round with the same results. Hand removal of seedlings is done when the population is greatly reduced.
Monterey Cypress *Cupressus macrocarpa*	13	Monterey cypress trees are cut at the base with a pruning or chain saw. Herbicide is not needed to kill the stump. Resprouts are easily removed by hand.

[8] Acreages of invasives were calculated using a combination of GPS data and visual estimates in the field. * Estimates for herbaceous invasive acreages (mustards/radish, Italian thistle, bristly ox-tongue, poison hemlock.) were likely underestimated due to time and seasonal constraints on mapping.

Invasive Pest Plant Species	**Area[8] (acres)**	**Treatment**
Silver Mountain gum *Eucalyptus pulverulenta*	11	After trees are cut, stumps are cut as low to the ground as practical and sprayed with 25% Garlon 4 herbicide.
Bristly ox-tongue*	9	Bristly ox-tongue is typically mowed 2-3 times prior to seed set, when present in predominately native grassland areas. For areas with dense invasive species, treatment may also include 2% Garlon 4 herbicide sprayed on the foliage prior to bolting.
English Ivy and German Ivy *Hedera helix & Delaria oderata*	7	English ivy and German ivy are controlled with 2% Garlon 4 herbicide. The plants are treated, by foliar spraying, year round with the same results. A second application is done 3 to 6 months after the initial treatment. The entire site must be sprayed with herbicide to ensure no runners are missed.
Monterey Pine *Pinus radiate*	5	Monterey pine trees are cut at the base with a pruning or chain saw. Herbicide is not needed to kill the stump. Resprouts are easily removed by hand.
Pampas Grass *Cortaderia jubata*	4	Pampas grass is treated with 2% Round-up Pro. Treated primarily in summer months before seed formation, but can be treated year round.
Italian Thistle*	3	Italian thistle is treated successfully by repeated mowing, or with herbicide prior to bolting, with 2% Garlon 4 herbicide that is sprayed on the foliage.
Mustard/Radish* Brassica/Hirschfeldia/ Raphanus	3	Mustard and radish are treated, prior to flowering, with 2% Garlon 4 herbicide that is sprayed on the foliage.
Acacia sp.	3	Acacia trees are cut as low to the ground as practical and sprayed with 25% Garlon 4 herbicide
Poison Hemlock* *Conium maculatum*	3	Poison hemlock is controlled with 2% Garlon 4 herbicide. The plants are treated, by foliar spraying, during the months of April and May.
Iceplant *Carpobrotus edulis*	<1	Iceplant is treated with 1.5% or 2% Round-up (or Rodeo) herbicide. Plants are treated year round.

Invasive Pest Plant Species	**Area[8] (acres)**	**Treatment**
Cotoneaster *Cotoneaster spp.*	<1	Cotoneaster is cut at the base with a pruning or chain saw. The stumps are treated with 50% Garlon 4. The herbicide is sprayed on cut stumps within 30 minutes of cutting.
Echium *Echium pinanana*	<1	Echium are cut and the stumps are allowed to decay. Treatment is done in the Summer, prior to flowering, when the plants are more visible.
Hairy cat's ear (*Hypocharis radicata*)	UNK	Hand pulling and/or use of glyphosate.
Veldt Grass *Ehrharta erecta*	<1	Handwork is conducted with Polaski's and herbicide treatment with Aquamaster.
Lolium multiflorum	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).
Hordium murinum	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).
Holcus lanatus	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).
Bromus diandrus	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).
Briza maxima	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).
Harding grass (Phalaris	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).
Orchard grass	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).
Tall fescue	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).
Bromus hordeaceus	UNK	Repeated mowing, and/or use of glyphosate, imazapyr, or Envoy (clethodim).

Handwork

Hand removal of invasive plants is an effective method for eliminating clusters of plants, especially seedlings and plants whose root structure is not prohibitively deep or large.

Hand removal is done with a maddox, weed-wrench, or by hand pulling. Removing the whole plant including roots is essential for control of most weedy invasive plants. Handwork is most effective in the winter and spring when soils are moist. Hand removal initial costs range from $25 to $400/acre depending on the density of the infestation. Annual maintenance work follows the same schedule as herbicide control work.

Herbicide

All herbicide control conducted on San Bruno Mountain is conducted by Certified Pesticide Applicators and in accordance with EPA approved label directions. Only spot treatment applications are done, and no broadcast application is conducted.

Herbicide control is typically used on mature, dense stands of invasives that are more cost effective to spray than to pull by hand. Most invasive pest plant infestations treated with herbicide are treated 2-3 times per year by foliar spraying. Spraying can be done year-round with the same results on certain species, while treatment must be done within a certain season (e.g. early spring for fennel) on others. The initial treatment typically has a 95% kill rate followed up with routine maintenance every six to twelve months for up to three years until the infestation is controlled. The majority of the originally sprayed plants will decay to skeletons in one to three years. Hand removal of seedlings can then be used when the population is greatly reduced. Burning should be considered to remove the biomass of dead plants and stimulate seedling germination. Once an infestation is controlled, there is still the potential for re-establishment due to either long-term seed viability in the soil, and/or the potential for seed dispersal from surrounding areas, and therefore ongoing monitoring is needed on at least an annual basis.

Currently (2007), it costs approximately $1000/ acre to apply initial spray treatments on medium to high-density infestations for most invasive species, and approximately $200 per acre for low-density infestations. Control of dense infestations that require intensive brush control or logging prior to herbicide control is not included in these estimates. After tree removal operations, spraying eucalyptus stumps costs approximately $1250-$1500 per acre, depending upon stump density. Typically, the cost for follow-up work is reduced by approximately 50% after 1 to 2 years, and by 75% after 3 to 4 years (Mike Forbert, pers. comm.).

More herbicide work is conducted on San Bruno Mountain than handwork, because herbicide work can be conducted faster than handwork and is more cost effective. The removal of weeds through handwork however has the benefit of removing weed biomass from sensitive areas. Herbicide application over successive years can create a dense layer of thatch, and this additional biomass on the soil tends to favor colonization by nonnative annual grasses, herbaceous weeds, and coastal scrub succession. This thatch layer, especially if composed of woody species, is slow to breakdown over time and is difficult to remove without burning or grazing.

Grazing

Grazing is the utilization of grassland (forage) by domestic livestock such as cattle, sheep, goats or horses. Where appropriate, re-introduction of grazing can be an effective means of maintaining the grassland habitat by reducing brush and tall annual grasses which out-compete native grassland plants including the butterfly host plants.

Since the cessation of livestock grazing in the early 1960's, and the more efficient prevention of fire since that time, the grasslands on San Bruno Mountain have reduced in a real extent as a result of the expansion of coastal scrub and the influx of weeds. During the 25-year span of the HCP, grazing has yet to be used on a large scale on San Bruno Mountain for habitat enhancement purposes. Though grazing was recommended as an important tool to utilize on the Mountain in the original San Bruno Mountain HCP, grazing has been regarded by many as an environmentally damaging activity. This is due to the history of overgrazing that has occurred on lands used for cattle grazing. The damage has occurred due to a single-minded focus on raising as many cattle as possible for dairy and meat products, without consideration of the impacts to vegetation and soils.

Depending upon a variety of factors, grazing can have a positive (encourage more natives) or negative (stimulate more invasives and erosion) impact upon a landscape. The number of animals, type of animals, season, duration and frequency of grazing events, and vegetation type are all variables that will influence the results of grazing. Grazing will effect soil compaction, soil nutrients, light, and both native and nonnative vegetation. Livestock type may be the most critical factor to consider due to the variation in diet preferences for different species and even breeds. For instance goats tend to focus on broadleaf species, cattle on grasses, and sheep on a combination of both grasses and forbs. In some cases, a combination of different livestock may be used together or in separate phases. The right combination will need to be determined through experimentation, and target goals and limitations need to be well understood.

There is substantial evidence that documents the impacts on the California landscape that have resulted from the removal of grazing and the suppression of fire. Grazing was an integral part in shaping and maintaining grassland communities over thousands of years (Edwards, 1992).

Research at Kirby Canyon and elsewhere has indicated that cattle grazing in the early spring is beneficial to native grasses if it is done prior to seed set of weedy annual grasses. Native bunchgrasses are less palatable at this time and their deep root structure is an adaptation which allows rebound after being grazed. Over time, a consistent practice of grazing in the early spring can result in a reduction of weedy annual grasses and perpetuation of native grasslands and native annual wildflowers (Lewis, Peterson, and Weiss, pers. comm.). Grazing can also be an effective tool for managing fire buffers.

A stewardship grazing plan was written for the Mountain in April 2002 (D. Amme, 2002). The document describes a rotational grazing program that would minimize the negative impact and maximize the beneficial impact of cattle and/or sheep on soils and plants.

A stewardship grazing program for San Bruno Mountain will need to be peer reviewed by experts in Stewardship Grazing, and should have the following components:

- A phased approach, with areas left ungrazed within each management unit;
- Conducted under a range of habitat conditions;

- Multiple year duration;
- Protection of sensitive areas from grazing animals (wetlands, oak woodlands, etc).

When properly managed, grazing may be a cost effective method of controlling invasive species and increasing grassland habitat. Grazing would have a high initial cost of $750-900/ acre to develop infrastructure, but would decrease each subsequent year and level off at $400/ acre or lower, depending on the economic value of the rangeland. Long-term grazing leases could also potentially bring in revenue to the HCP.

Certain grasslands on San Bruno Mountain, such as moist north-facing grasslands containing dense stands of *Festuca sp*. And/or *Calamagrostis nutkaenisis* have a high native species component, and may be more resilient to invasive species and coastal scrub succession than grasslands on dryer exposures. These grasslands are located on upper elevation slopes, and have high moisture levels from coastal fog influence. These areas should not be grazed without careful analysis that determines that grazing is appropriate and beneficial to the native species.

Grazing can also have short-term negative impacts on the sensitive species (through direct take of adults, caterpillars, pupae, and/or eggs) from trampling; however long-term impacts are likely to be beneficial due to the removal of thatch and stimulation of host and nectar plant recruitment. Application of grazing would need to be conducted on a rotational system to provide a sufficient quantity of ungrazed refuge habitat for the butterflies at all times.

Goat Grazing

A 2-year pilot grazing and mowing project on San Bruno Mountain was conducted from March 2003 to July 2004. Grazing was tested for its efficacy in controlling weeds (specifically: wild oat, ripgut brome, Italian thistle, fennel, and Oxalis), and reducing coastal scrub. Grazing using goats was conducted in 4-5 separate corrals in March 2003, June 2003 and March 2004. Plant species, percent cover data, and residual dry matter (RDM) was collected prior to the grazing treatments in March 2003, and again in March 2004. The project was cancelled after two years due to budgetary constraints.

The goal of the pilot grazing and mowing experiment was to test the efficacy of controlled livestock grazing as a tool to enhance and restore the health and diversity of native grassland plant communities. Specifically, the program targeted rank annual grasses and weeds that suppress the diverse native herbaceous and perennial grassland plant community and reverse the encroachment of coastal scrub into grassland areas. The pilot program included labor and material required to conduct mowing and managing a herd of goats (100 – 400 animals).

Results of the goat grazing experiment were not conclusive, and this may be due at least in part to the short duration of the project. The project was funded for only two years, and grazing projects typically require approximately four successive years of implementation before a significant reduction in targeted invasive species can be obtained (Peischel, pers. comm.). Over this period, goats were not found to significantly reduce annual grass or herbaceous weed cover. Goat grazing however was found to significantly reduce residual dry matter (RDM) within the grasslands, and in combination with native grass seeding, a significant increase in native grass cover was observed.

Maintaining an appropriate level of RDM allows for development of annual and perennial grasses and wildflowers, retains water in the soil, and discourages erosion. Recommended ranges for RDM in coastal prairie grasslands with minimal woody plant cover range from 1,200

to 2100 lbs/ acre (UC Davis, 2002). The East Bay Municipal Utility Department uses RDM guidelines of 840, 1120, and 1400 lbs per acre for flat, gradual and steep slopes respectively (EBMUD, 1996). In contrast, RDM values measured within the grasslands in the Hillside/ Juncus area on San Bruno Mountain prior to grazing treatments in 2002, showed RDM levels of 5000 to 9000 lbs/ acre (Figure 16). This level of RDM is indicative of unhealthy grassland conditions. While goat grazing was not found to be effective at reducing European annual grass coverage, it was found to reduce RDM levels by an average of 32% within grazing treatment plots, while control plots increased in RDM by an average of 8% over the same period (San Bruno Mountain data).

Cattle Grazing

Cattle grazing has proven to be a cost effective tool for managing serpentine grasslands and protecting habitat for the federally Threatened bay checkerspot butterfly at Kirby Canyon Conservation Land Trust in Santa Clara County (Figure 17). Cattle grazing has also been tested within non-serpentine coastal prairie habitats, and native annual forbs were found to increase within grazed plots (Hayes, et al 2003), however native perennial forbs were found to have higher coverage within non-grazed plots.

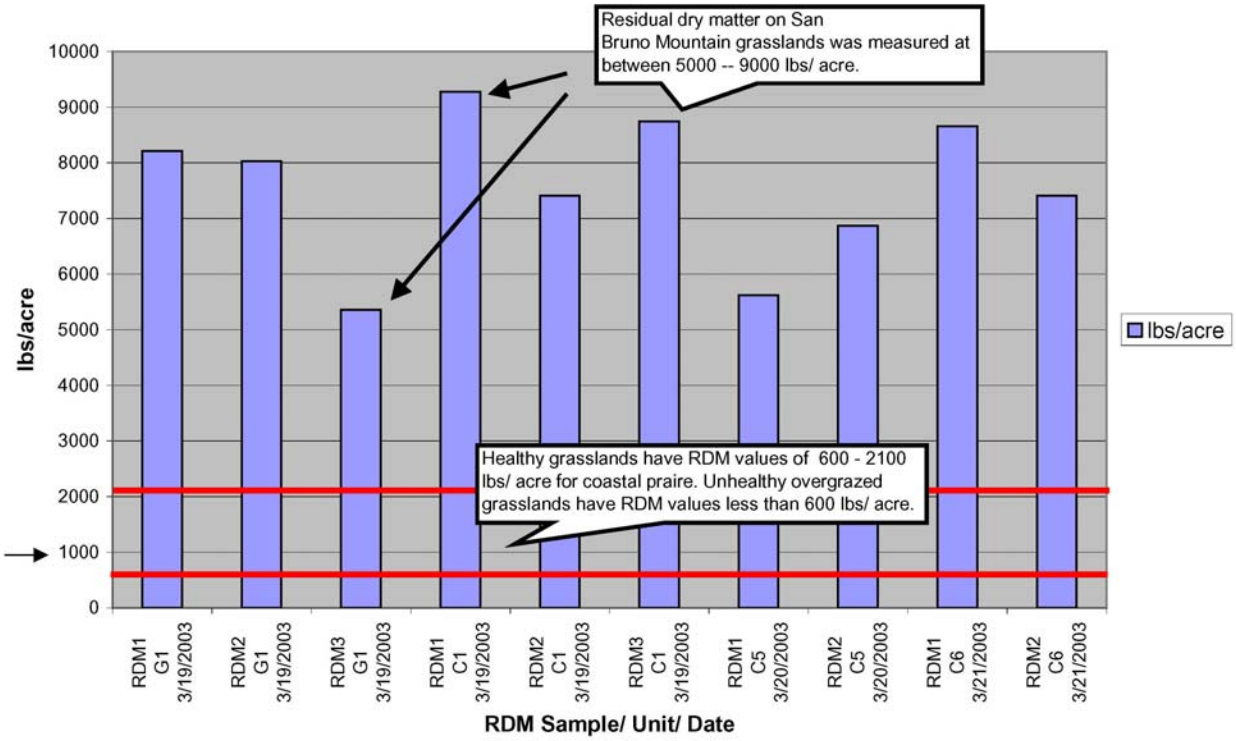
The cattle grazing program at Kirby Canyon utilizes low intensity grazing with 1 cow/calf per 10 acres and two grazing periods per year, one in winter/spring and one in summer/fall. Cattle are allowed to graze over large paddocks, approximately 1,000 acres or larger. Ranchers typically remove their cattle from the conservation area in April, coinciding with the time that the cattle stop gaining weight and when annual wildflowers come into bloom, including the host plants for the federally threatened bay checkerspot butterfly.

Because some of the host plants (e.g. lupines) on San Bruno Mountain are less palatable to grazing animals, they tend to increase within areas grazed by cattle or sheep. A grazing regime also crops and limits the seed production of annual grasses, thereby improving the competitive position of broadleaf species (wildflowers) so that they maintain a higher overall density within the grassland.

Native Grazing Animals

Native grazing animals such as Tule elk were likely an important component in maintaining the grasslands of San Bruno Mountain in the past. This species, though nearly extirpated by the beginning of the 20th Century, has made a comeback and herds have been introduced into 21 different open space areas in California. These herds are overseen by the California Department of Fish and Game. Release sites for Tule elk need to be several thousand acres in size to maintain a genetically viable and healthy herd. San Bruno Mountain would not provide enough habitat to support a viable herd for Tule elk, and would create a ‘captive herd’ situation that would require expensive and ongoing management including contraception, culling, and bringing in individuals from other herds on a routine basis to maintain the genetic health of the herd (Palmisano, pers. comm.).

Figure 16. Residual Dry Matter (RDM) Values Measured on San Bruno Mountain, 2003



Burning

Wildfire is a natural process that has shaped the native flora of California. Historically, moderate-intensity wildfires would occur in grassland, scrub, and forest habitats in the summer and fall on a frequency generally once every few decades. In habitats that have evolved with wildfire, an absence of burning results in a shift in community composition. Vegetation becomes age-stratified as older, larger species inhibit new growth and recruitment. Diversity decreases in the absence of fire as species that either require fire for regeneration or require the space and nutrient flush that follows fire begin to disappear.

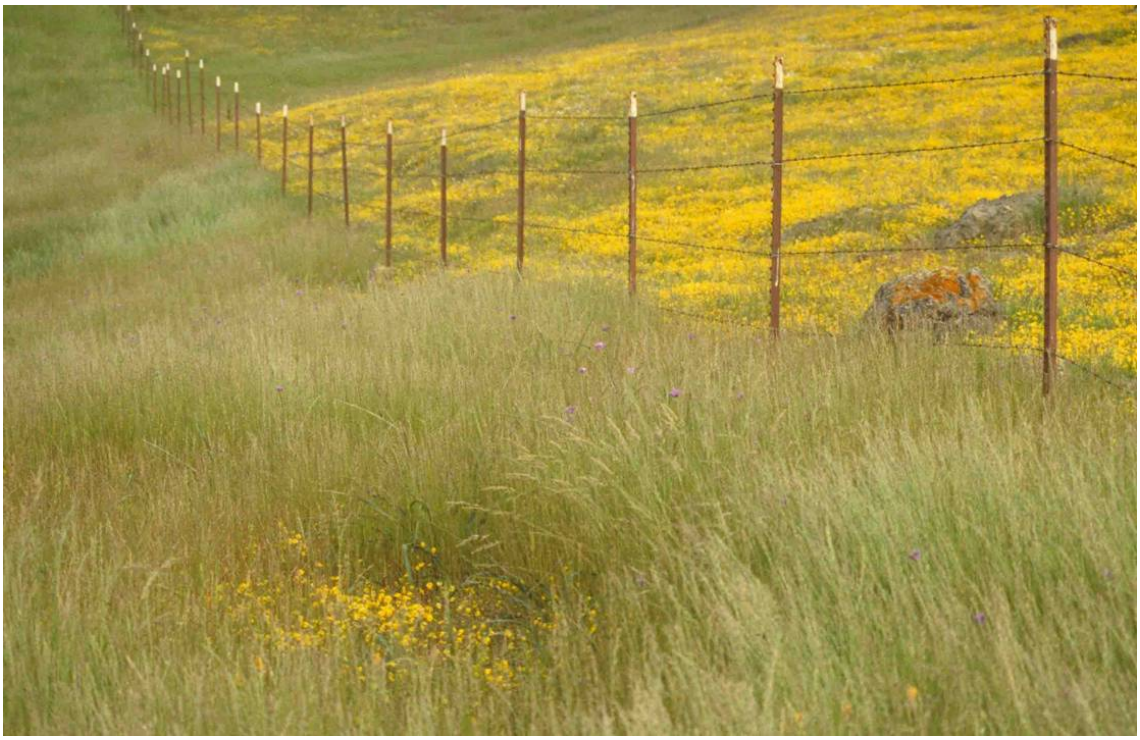
Due to the documented expansion of coastal scrub on the Mountain and the corresponding loss of butterfly habitat over the course of the HCP, burning may be an important tool for reversing this trend and for achieving long-term sustainability of the grasslands and butterfly habitat on the Mountain. However, because San Bruno Mountain is an open space area that is surrounded by dense urban and suburban development, the ability to allow wildfires to burn or to implement prescribed burning on a regular basis (if even at all), is not a reliable option for habitat managers. Burning on San Bruno Mountain is further restricted by air quality regulations that prohibit burning on days of poor air quality. Though prescribed burning, especially on a small scale, may be permitted from time to time, the vegetation management program cannot rely on the implementation of prescribed burning to meet the goals and objectives of the program.

Research by TRA and others has shown that invasive species such as gorse and French broom regenerate strongly after fire, and that post-burn control of seedlings is paramount to gaining control of the invasives. Any burning projects implemented on the Mountain will need to include a management plan for follow-up weed control. Also, wherever burning is conducted on slopes with erosion potential, proper methods for erosion control and soil stabilization will be employed.

Burning can have short-term negative impacts on the sensitive species (through direct take of adults, caterpillars, pupae, and/or eggs) but long-term impacts are likely to be beneficial due to the removal of thatch and reinvigoration of host and nectar plants. Application of burning would need to be conducted on a rotational system to provide a sufficient quantity of unburned refuge habitat for the butterflies at all times.

Figure 17. Effects of Cattle Grazing at Kirby Canyon Land Trust in Santa Clara County

Left side of fence line shows an ungrazed grassland area dominated by European annual grasses, while the right side of the fence line shows the grazed area that is dominated by native annual wildflowers.



Prescribed Burning

The introduction of a burning regime similar to what occurred historically on San Bruno Mountain could be instrumental in maintaining native grasslands. Prescribed burning on San Bruno Mountain could be used to achieve two main habitat management objectives. Firstly, fire could be used to clear out native and non-native scrub in areas that previously supported grasslands, such as the lower slopes south of the Brisbane Industrial Park. A second management objective for which prescribed burning may be beneficial is for the maintenance of grassland habitat, through the removal of dead vegetative biomass (thatch) which inhibits

regeneration of grassland plant species. Controlled burning could also have a beneficial impact upon certain rare plants on the Mountain, such as the San Bruno Mountain manzanita.

To achieve the habitat management goal of maintaining or promoting native habitat, the burning prescription should mimic the historical and natural fire regime as closely as possible. This includes burning in conditions under which a wildfire would be expected to occur; specifically, in the summer/fall dry season (June to October). Burning under moist and cool conditions may actually damage native species, and result in favoring invasive species over native vegetation. As the time of year that a burn occurs influences the vegetation's response to the burn, some management goals may not be achievable by burning in the winter or spring. When the objective of prescribed burning is simply to clear out vegetation such as coastal scrub or dense infestations of invasive species, burning under damp conditions would still be expected to meet program goals.

If some level of prescribed burning is to be employed for managing vegetation, the Habitat Manager will work with San Mateo County Parks, the California Department of Forestry, and Bay Area Air Quality Management in coordinating burns on San Bruno Mountain. Burning will be conducted under the authorization and direction of CDF, and implementation will require the assistance of CDF. Any burning conducted will be consistent with *The San Bruno Mountain Community Wildfire Protection & Fire Use Pla*n (CDF and TRA 2005).

The *San Bruno Mountain Community Wildfire Protection & Fire Use Plan* provides a mechanism for reviewing sites for conducting fuel reduction and vegetation management utilizing fire as a management tool. The Plan does not include any specific sites for implementing prescribed burns. CDF develops prescribed burn plans through the Vegetation Management Plan (VMP) process based on site-specific information. Environmental impacts must be evaluated consistent with CEQA for each proposed project. Mitigations for the listed species in the HCP are one important component of a VMP on SBM, although many other potential impacts to the environment are also considered. Any VMP that is developed for SBM must comply with the HCP and requires consultation with the USFWS, California Department of Fish and Game, Regional Water Quality Control Board, Bay Area Air Quality Management District, archaeologists and Native American representatives, California Geological Survey as well as other experts and interested groups on SBM.

When the fire defense system is in place (i.e., buffer zones, fire breaks, fire roads, treatment of hazardous fuels) implementing prescribed fires on San Bruno Mountain may be considered. The cost of prescribed burning is difficult to estimate due to the high variability in planning costs.

Pile Burning

Pile burning is incorporated into this management program as a valuable tool for reducing the accumulation of brush (wildfire fuels) and for decreasing native scrub and invasive species coverage. Vegetation is hand pulled and piled on site during the winter and spring months when the ground is soft and humidity and fuel moisture levels are high. Piles are then burned by the CDF, and the risk of fire escape is negligible.

Combined with mowing and/or grazing, pile burning is an excellent tool for opening up areas for conversion to grassland and for preparing areas for replanting. Post-disturbance follow-up weed control is critically important to control the flush of weeds that may occur in areas following clearing and pile burning activities. This follow-up is necessary after virtually any natural event

(slope failure) or management activity (pile burn, wildfire, prescribed burn, mowing or grazing treatment) due to the aggressiveness of invasive weeds in colonizing recently disturbed soils.

Pile burning could not be used for the goal of removing thatch from grasslands. Rather prescribed burning, mowing and/or grazing can be used to remove or breakdown thatch and cycle carbon and nutrients back into the soil. Pile burning can be conducted at a relatively low cost with CDF prison crews at approximately $500 per acre.

Micro-Burns

Given the constraints, and the likelihood that broad-scale prescribed burns may be difficult to implement, micro-burns (burns on the order of a few hundred square meters or less, and contained in fire-proof fencing) might prove useful and feasible. These small burns can aid in combating localized weed or scrub infestations or thatch build-up and may be more easily permitted. Given their small size, they cannot be used for broad scale management. Planning and implementation of micro-burns would need approval from CDF.

To be an effective tool for the maintenance of grasslands, micro-burns would need to be conducted in the summer or fall to meet grassland maintenance goals. Micro-burns in the winter may damage grassland species, as they are not adapted to burns in the winter. At this time, CDF is unlikely to approve dry-season burns on San Bruno Mountain.

With the establishment of fire breaks and buffers, micro-burns may be a promising tool for habitat management in the future. Micro-burns could be utilized to achieve goals that include for example the removal of gorse thatch or broom. The cost associated with micro-burns however, for fencing, planning, supervision, and follow-up work, would need to be considered and may outweigh the benefits.

Wildfires

The California Department of Forestry and Fire Protection (CDF) has the primary fire protection responsibility for protecting the natural resources of San Bruno Mountain from fire damage. CDF can be available for road and firebreak maintenance with dozers, graders and hand crews to do the work. CDF may also be available for assistance with buffer zone establishment and maintenance. Buffer zones are areas adjacent to development where vegetation must be modified to reduce the fire hazard.

The San Bruno Mountain Community Wildfire Protection & Fire Use Plan does not provide a “let burn” policy for wildfire. The plan does state that when the fire defense system is in place (i.e. buffer zones, fire breaks, fire roads, treatment of hazardous fuels) managing unplanned fires on San Bruno Mountain may be considered.

Flaming

Flaming involves using a gas torch to pass intense heat over the leafy parts of a plant. The heat causes the plant cell walls to burst, killing the plant. Flaming can be used on young, emerging weeds without affecting established, desirable plants and it leaves no residue. Flaming is not effective on weeds with underground reserves. Disadvantages to flaming include a lack of residual control, poor effectiveness on some grasses and perennials, critical timing requirement to ensure adequate control, hazards associated with handling pressurized flammable gas, and the potential for fire. Flaming may be effective on invasive species such as French Broom, and should only be used during the wet season, during appropriate conditions. Costs for flaming are

estimated at approximately $500 - $2000 per acre, depending upon the density of the infestation treated.

Fire Breaks and Buffers

Areas adjacent to developments should be grazed, hand weeded or mowed rather than burned, to create a sizable fire buffer zone between potential wildfires and residential and commercial areas. For some areas such as the Brisbane Acres, where there are abundant fuel loads present from dense eucalyptus woodland in the ravines, extensive work to remove ladder fuels is needed. The clearing of vegetation to create fire buffers on San Bruno Mountain is an opportune management action for CDF prison crews.

The creation of fire buffers will not only provide a level of protection to homes and businesses in the event of a wildfire, but may also pave the way for future prescribed burning on the Mountain. As discussed above, the greatest limiting factor to prescribed burning on San Bruno Mountain is the proximity of urban development and the risk posed to structures in the event of a fire. By creating and maintaining a buffer between development and wildland, the risk of fire spreading from the Mountain and onto adjacent properties is greatly decreased.

Fire breaks and roads on the Mountain are not consistently maintained by CDF, partly due to concerns over impacting endangered species habitat on the road cuts, especially mission blue butterfly habitat. Ongoing coordination between the Habitat Manager and CDF to maintain fire breaks and minimize impact to the endangered species is needed. As specified in the *San Bruno Mountain Community Wildfire Protection & Fire Use Plan*, CDF can be available for road and firebreak maintenance with dozers, graders and hand crews to do the work. Future maintenance and road and firebreak work may include:

- Maintaining firebreaks in the South Slope areas at a 25-foot width.
- Assisting with road maintenance by installing erosion control features and grading existing roads.
- Developing new firebreaks as needed in cooperation with San Mateo County Parks and the HCP Habitat Manager.

Any work to be done by CDF on roads or firebreaks must be coordinated with the HCP Habitat Manager to minimize direct impacts to sensitive habitat.

Mowing

Mowing has shown to be an effective tool and is used frequently as part of the current ongoing grassland management of San Bruno Mountain. Mowing can be used to depress invasive species in the same manner as grazing and burning, and has shown to be successful within specific areas, such as on the preservation parcel on the Southeast Ridge, the Hillside/Juncus area, various restoration sites (habitat islands), and along the Summit Ridge Trail. It is especially useful within highly sensitive areas, to avoid impacting rare species.

Mowing has been found to be effective at reducing annual grasses and providing a competitive advantage to native species, including the host plants for the mission blue butterfly. It does not reduce thatch levels within the grassland however, unless thatch is raked and removed from the treatment area.

Though mowing is effective, it cannot be effectively implemented on a large scale to address annual invasive species. A GIS analysis of slopes was done to determine the extent of San Bruno Mountain that could be mowed. Most of the grassland acreage (approximately 75%) is on very steep slopes that cannot be cost-effectively mowed with labor crews. Where slopes are more gradual and accessible, mowing is a cost effective tool for controlling invasive species.

Mowing needs to be conducted repeatedly, 2-4 times per year, and prior to invasive species seed set. Mowing can be done with a tractor mower for large areas, or with a weed-eater for small areas. Mowing costs approximately $500 per acre with a tractor mower, and $750 per acre for weed-eater mower.

Brush and Tree Clearing

Clearing of unwanted brush and trees, such as broom, gorse, coyote brush, Monterey pine and eucalyptus may be accomplished by a variety of means. Private contractors, the California Conservation Corps, County Fire Safe crews, and CDF prison crews have been used for brush clearing projects on San Bruno Mountain. At this time, CDF prison crews are the most cost effective method for attaining the desired results. The CDF prison crews are staffed with approximately 12 non-violent crime inmates per crew and are supervised by a CDF crew chief and the San Bruno Mountain HCP Habitat Manager. Crews are trained and provide their own tools, with the exception of weed wrenches which are provided by San Mateo County Parks Division.

CDF crews are most efficient in areas that are dominated by brush and/or invasive species and where sensitive habitat is minimal. Ideal areas for crew work include large infestations of broom and coastal scrub targeted for conversion to grassland. The benefits of using CDF prison crews is that a large amount of work can be accomplished for relatively low cost and there is less disturbance to the soil than from mechanical clearing. After the vegetation is cleared it is pile burned, creating openings for reseeding and/or planting. Cost for brush control depends on the density of the brush and the terrain. Cost for brush control with CDF prison crews can range from $500 to $1500 per acre.

Mechanical methods for brush and tree removal may successfully meet management goals, but generally at a higher cost. A Brontosaurus (a large cutting head mounted on a tracked caterpillar) can effectively remove brush where hand removal or grazing is not feasible. The Brontosaurus removes and chips brush and small trees in a single operation. Approximately 60 acres of dense, mature stands of gorse and Portuguese broom have been removed with a Brontosaurus from the Saddle and the Northeast Ridge as part of the State Parks Grant and other projects. The cost of brush removal using this equipment is approximately $1,500 per acre, including post-clean up of debris.

Removal of eucalyptus forest or other large trees requires logging. The most recent logging of eucalyptus occurred within the Colma Creek restoration area in 2006. Approximately 150 large and small trees were felled and chipped on site. Once cleared, areas that previously supported eucalyptus forest may be returned to native habitat with the replanting of native vegetation and follow-up removal of eucalyptus seedlings or saplings. The cost for logging is approximately $8,000-10,000 per acre.

Brush and tree clearing should be conducted in the fall or winter (September 1 to February 1), to avoid impacting nesting birds unless pre-project surveys for nesting birds are conducted and impacts are determined to be insignificant. Brush clearing conducted in the fall will also be more efficient since clearing in the fall may kill coyotebrush and other shrub species outright,

since these species are drought stressed at this time of year (personal communication David Amme). Brush control activities should not be conducted within a 100-foot buffer zone on both sides of drainages, unless these activities are deemed necessary to remove an invasive species, protect a listed species, and/or soil and slope aspects provide suitable conditions for grassland restoration within the buffer zone.

Re-seeding

Re-seeding in areas that have been managed for unwanted vegetation or that have been disturbed is desirable and at times crucial for the establishment of native vegetation, particularly grasses. Often times the soil seed bank is dominated by annual invasive grasses, and the natives are not able to gain a foothold following a disturbance event such as a wildfire. In areas that have long been dominated by invasives, the density of the native seed in the soil may be markedly diminished. Re-seeding with locally grown, native seed is the best practice, but due to cost, it often cannot be used over broad areas. Instead, re-seeding is used only in specific areas that have had intensive invasive species control work, have a high erosion potential and/or within habitat restoration islands. Examples of the latter include areas where vegetation is being grazed down, following fire, or after removal of species that form mono-specific stands, including Oxalis and Himalayan blackberry.

Seed mixes should to the greatest extent possible be composed of local seed sources, and even collected on site when available. This is to maintain the unique and specific genetics of San Bruno Mountain and to prevent hybridization with similar, yet genetically distinct, stock. Driving seeds into the soil either mechanically or via hoofed animals (in areas that are grazed) will protect seed from predation and increase germination rates.

Mycorrhizal Inoculation

Mycorrhizal fungi are present in most native coastal sage scrub soils. However, most coastal sage scrub species are only facultative users of mycorrhizal fungi and do not require their presence to establish on site (St. John, 1995). These fungi grow into the root tip cells of the plants and form a symbiotic relationship with them. This relationship allows the fungi to obtain some of its nutrient needs from the plant and helps the plant obtain phosphorus, which can sometimes be difficult for plant roots to extract. In general, mycorrhizal populations are eliminated from highly disturbed sites through the removal of topsoil and other soil disturbance activities. However, if appropriate native species are reintroduced to a site, it appears the associated mycorrhizal fungi will return in 1-5 years (Nelson and Allen, 1993). There is currently a debate over whether it is useful to introduce mycorrhizal fungi to coastal sage scrub restoration sites. Experiments done with coastal sage scrub species and non-native grasses where mycorrhizae were introduced showed that non-native grasses may obtain a competitive edge because they put on more top growth while native species increase root growth (Nelson 1995). A few practitioners feel that no restoration can be truly successful without mycorrhizae (St. John, 1995). The cost of utilizing mycorrhizal fungi for invasive control has not been determined.

Nutrient Fixation

Soil testing at each restoration site should be accomplished on a regular basis (once or twice each year). If nutrient levels are found to be higher than what is normally expected, remediation should be accomplished. This can be done through the addition of recalcitrant mulch, such as bark or wood chips, to the soil. This will provide an additional source of carbon for microorganisms, in particular soil fungi, which will enable them to increase in numbers and

therefore take up the available nitrogen from the soil through the process known as nitrogen fixation. This will both decrease the amount of available nutrients in the soil and provide a "slow-release" process, caused by the re-release of nitrogen into the soil as the micro-organisms slowly die off, that will benefit the native species over the non-native exotics. The cost of utilizing nutrient fixation for invasive control has not been determined.

Replanting

While much greater effort and expense has gone toward habitat maintenance and enhancement, replanting[9] has been used with success when areas have been properly selected and thorough follow-up work has been done to protect plantings. Smaller habitat islands, approximately 1 acre or less in size, can be planted and more easily managed to provide habitat for the endangered species once host and nectar plants have become established. This process takes approximately 2 years. Several habitat islands for the mission blue butterfly have been created within HCP conserved areas using this approach (Figure 19).

Typically all broadleaf plants are grown from seed stock collected from San Bruno Mountain. Collection of seed and allotting enough time for propagation (6 months to one year) must be considered for replanting projects. All host and nectar plants for the endangered butterflies must be collected from San Bruno Mountain to avoid any potential for hybridization between varieties from other regions.

Costs range from $500 per acre for reseeding with native grasses to $10,000 per acre for growing and installing native plants.

The availability of native grass seed for restoration projects on San Bruno Mountain has been a limiting factor in reseeding areas after disturbance from fire, brush clearing, and slope stabilization. A program of growing and storing an ample supply of native grass seed for the Mountain, either grown on the Mountain itself or within the region is needed. If additional funding can be secured, a portion of HCP funding should be used to provide ongoing support to assist in the development of a native plant nursery that would provide a sustainable supply of native plants and grass seed for San Bruno Mountain restoration projects.

Volunteer Assisted Habitat Management and Restoration

- Training
- Monitoring weed free areas (weed patrol)
- Weeding days
- Supervision

The San Bruno Mountain HCP has not relied on volunteers for meeting management or monitoring goals in the past, and this habitat management plan does not recommend such reliance in the future. Volunteer assistance however is important towards increasing the overall

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9 The term “restoration” is used to refer to land management that includes replanting and/or reseeding with native plant species; whereas “maintenance” or “enhancement is used to refer to invasives control, brush control, or other techniques that do not include replanting/reseeding efforts.

success of the program, and this should be cultivated through the development of a more organized and large-scale community stewardship program for the Mountain.

The role of volunteers on San Bruno Mountain is an important aspect in management. Volunteer activities provide the important connection between the Mountain and its management needs and the surrounding community. Volunteers have had a beneficial impact on the Mountain's management through assistance with weed control, plant propagation and planting, public education, and in providing feedback to Park and Habitat Managers. Volunteer activities on the Mountain have focused primarily on four locations to date: 1) The Botanic Garden area (by Friends of San Bruno Mountain), 2) Owl and Buckeye Canyons (by San Bruno Mountain Watch), 3) Pointe Pacific Property (by Pointe Pacific Homeowners Association), and 4) Colma Creek (by Heart of the Mountain). In addition a native plant nursery (Mission Blue Nursery) was founded in 2002 and is operated by volunteers with the Friends of San Bruno Mountain. The Nursery is currently being relocated from its former site in South San Francisco to Brisbane.

Through the period of 1996 to present, the results from these activities have been successful and very encouraging. As the volunteer base for these organizations builds, there is the potential for expansion of volunteer activities into other habitat areas of the Mountain, which will increase the effectiveness of habitat maintenance and restoration efforts. Under grant programs, volunteer organizations now have the capability of conducting large-scale vegetation management projects, as exemplified by projects such as the San Bruno Mountain Watch Coastal Conservancy Grant Project in Owl and Buckeye Canyons. The County will continue to coordinate with volunteer organizations as their programs develop.

Combination of Techniques and Ongoing Management

For successful habitat maintenance or restoration, it is often necessary that several techniques be used. The types of techniques used in combination will depend upon the vegetation community, invasive species type and density, slope exposure, grazing infrastructure, distance to residential areas, wind patterns, and other factors.

For habitat management projects on San Bruno Mountain, the initial treatment of invasives and the clearing of brush and/or trees requires regular follow-up work using hand weeding, herbicide control, mowing and potentially reseeding and planting for at least 3-5 successive years. Success of these management techniques depends upon a funding mechanism that can support their repeated use over the course of several years.

Even after a site is stabilized with native vegetation, ongoing management is still required, due to the need for episodic disturbances (in the form of grazing, mowing, and/or burning) to maintain the health of native grasslands and coastal scrub plant communities. Therefore even the most pristine areas of the Mountain, and the most successful restoration sites, will still require ongoing management in one form or another, in perpetuity.

B. Methods for Directly Enhancing Butterfly Populations

Captive Breeding

Captive breeding and reintroduction of mission blue, callippe silverspot, and San Bruno elfin butterflies is not necessary or foreseeable at this time based on the current status of the populations. All of these species are locally abundant on San Bruno Mountain. Based on their home range size, flight capabilities, distance between habitat patches, and lack of significant

movement barriers, it is likely that all suitable habitat is being utilized and genetic exchange is occurring between butterfly colonies throughout the Mountain.

Reintroduction of the bay checkerspot butterfly could potentially be done on the Mountain, however the current limited extent of the habitat for this species would make re-establishment of this species difficult. With continued management of the Mountain to increase the extent of grasslands, re-establishment of the bay checkerspot butterfly could become possible in the future.

A captive breeding program for any of the listed butterflies occurring on San Bruno Mountain would need to be overseen by the USFWS, and any physical handling of the listed butterflies would need to be conducted and supervised by a USFWS permitted biologist.

Genetic Exchange Program

Genetic exchange between butterfly populations on San Bruno Mountain and other isolated open space areas that support the mission blue butterfly, callippe silverspot butterfly, and/or San Bruno elfin butterflies should be considered and investigated. Areas where very small populations of mission blue are present (Twin Peaks, Milagra Ridge), and San Bruno elfin (Milagra Ridge) would likely benefit from a genetic exchange program that introduces genetic material (in the form of female butterflies) to provide greater genetic viability to these isolated populations. This program would need to be overseen by the USFWS, and any physical handling of the listed butterflies would need to be conducted and supervised by a USFWS permitted biologist.

VI. HCP HABITAT MANAGEMENT ACTIVITIES (1982 – 2007)

Since the inception of the HCP in 1982, habitat management has focused on using herbicide, hand control, and mechanical removal to control weed infestations, with a primary emphasis on protecting grassland habitat areas for the mission blue, callippe silverspot, and San Bruno elfin butterflies. In addition, work has focused on protecting areas with high native plant diversity and rare plant populations. The previous management plans (San Bruno Mountain Exotic Species Control Program, 1993; and The San Bruno Mountain 5 Year HCP Strategic Plan, 1996) identified the distribution of invasive species and treatment methods and strategies to control these species. The 1993 Plan focused primarily on gorse (*Ulex europaeus*), blue gum eucalyptus (*Eucalyptus globulus*), French broom *(Genista monspessulana*.), Portuguese broom (*Cytisus striatus),* and fennel (*Foeniculum vulgare*), and expanded the invasives control program from its original primary focus within habitat areas on the main ridge, Saddle, and Northeast Ridge to include areas on Southslope, Southeast Ridge, and Brisbane Acres. A more systematic approach to controlling gorse was described in the 1993 plan and implementation of this strategy has contributed to the control of this species (see below).

The 1996 Plan further expanded the number of invasive species to be controlled to include pampas grass (*Cortaderia selloana*), Monterey pine (*Pinus radiata*), Monterey cypress (*Cupressus macrocarpa*), poison hemlock (*Conium maculatum*), Pride of Madeira (*Echium ssp*.), Cotoneaster (*Cotoneaster ssp*.), Cape ivy (*Delaeria oderata*), and English ivy (*Hedera helix*). The 1996 Plan also expanded the program to address invasive species on a Mountain-wide scale and provided an estimate of the level of invasive species control that could be expected under different funding scenarios.

A. Invasive Species Control

As of 2007, habitat management over the 25-year span of the HCP has reduced the extent of gorse on the Mountain by approximately 85%, and the extent of eucalyptus by approximately 30%. Gorse has been controlled since 1993, using brush clearing and herbicide control. Recent work on gorse over the past 4 years through a California State Parks grant has resulted in the control of an additional 49 acres of gorse in the central Saddle.

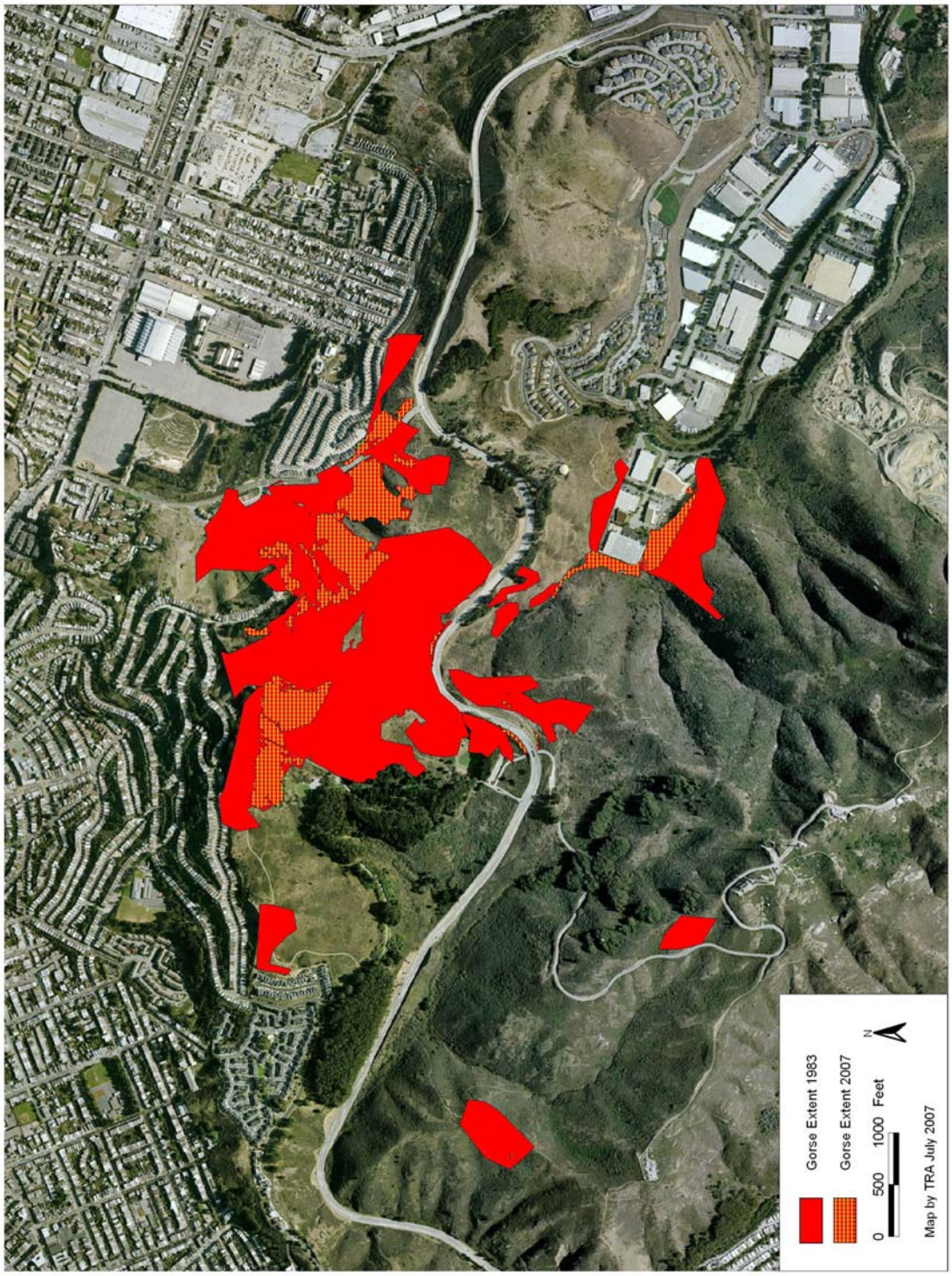
The management strategy that has been employed has reduced the amount of gorse in the eastern and western Saddle and has prevented the spread of gorse to other areas. The mission blue and callippe silverspot habitat in the Saddle is primarily limited to the eastern Saddle and therefore this area has received consistent control efforts to maintain this habitat free of gorse. This approach has effectively contained gorse to a 34-acre area of the central Saddle, however the density of gorse has increased within this area. Figure 18 shows the current extent of gorse on San Bruno Mountain.

Approximately 45 acres of blue gum eucalyptus forest has been logged and controlled over the past 12 years on San Bruno Mountain (Figure 19). Areas where eucalyptus has been controlled include Wax Myrtle Ravine (10 acres), Dairy Ravine (21 acres), Colma Creek (4 acres), April Brook (4 acres), Colma Creek Headwaters/Bog (2 acres), and Hoffman/West Peak (4 acres). The control and management of the eucalyptus-logged areas required an extensive expenditure of HCP funds between 1995 and 2001 to restore these areas to native habitats. Extensive slash removal through mechanical removal and burning was conducted, and thorough and repeated follow-up invasive species control work was performed. Areas that have been treated to control gorse and eucalyptus require ongoing management due to the influx of other invasive species such as poison hemlock (*Conium maculatum*) and Himalayan blackberry (*Rubus*

discolor). Through the eucalyptus control work, a mosaic of coastal scrub and grassland has returned to these areas, though weed control is an ongoing challenge.

Though the previous management approach for the Mountain has worked well in directing control efforts toward the most serious invasive species threats and has protected the core habitat areas of the endangered butterflies, it has not been capable of addressing the need for management of brush and herbaceous invasive weeds on a broad scale. Herbaceous invasive species (Italian thistle, bristly ox-tongue, mustards (*Brassica ssp. / Hirschfeldia ssp*.), wild radish, poison hemlock, rattlesnake grass and velvet grass) have expanded on the Mountain in the absence of large scale control (Figure 20). In recent years (2005 and 2006) focused control efforts on herbaceous species such as Bermuda buttercup (*Oxalis pes-caprae)* has led to successful control within specific areas. Many of these species are not easily controlled through herbicide or hand control methods, and are more difficult to track as they can invade new areas quickly due to wind or other mechanisms of seed dispersal. Though these species have been removed by HCP crews and volunteer groups for many years, addressing these species on a large scale has not been feasible.

Figure 18. Change in Gorse Distribution on San Bruno Mountain 1983 - 2007



B. Habitat Restoration

The term restoration is used to refer to areas where both invasive species control and replanting of native species is conducted. Within the conserved habitat, establishment of butterfly habitat (primarily mission blue) has been created within former gorse and eucalyptus infestations in the Colma Creek area, Dairy Ravine and Saddle through the creation of habitat islands. Habitat islands are areas approximately 0.1 - 1.0 acre in size that can be managed more thoroughly using mowing, hand control, herbicide and replanting to establish and maintain butterfly host and nectar plants. As of 2007, five HCP habitat islands have been established, and three of these sites have had documented mission blue butterfly utilization (Figure 21).

Habitat islands have also been established by developers and agencies on temporarily disturbed slopes that are to be restored and dedicated to the HCP conservation area. Nine habitat islands have been created thus far that provide potential habitat for mission blue and callippe silverspot butterflies. Four of these islands have documented occurrences of mission blue butterfly as of 2007. Most of the habitat islands established thus far on temporarily disturbed slopes are located on the Northeast Ridge (Figure 21).

The habitat island approach has been used as a method for creating or enhancing endangered species habitat through the planting of host and nectar plants in suitable locations. The creation of the islands has provided additional habitat for the mission blue butterfly, and potentially buffers the butterfly population from impacts from coastal scrub succession and host plant dieback at existing habitat areas. Creating habitat islands also provides potential educational opportunities for volunteers, and creating a program to attract and train volunteers to assist in the management of habitat islands is being explored by the County Park staff at this time (2007). In the past 5 years (2003 – 2007) approximately 6% of the annual HCP budget ($5,000 - $10,000) has been used to create and manage habitat restoration islands.

While habitat islands have been created for the mission blue butterfly, and can be created for the San Bruno elfin butterfly, it is unknown if the habitat island approach is appropriate for the callippe silverspot butterfly. The callippe relies on much larger areas (minimum of several acres) that consist of its host plant, *Viola pedunculata*, and near topographic high points. Due to the high cost and difficulty of propagating Viola, restoration of callippe habitat is likely better served through large scale brush removal that opens up grassland habitat and allows for natural recruitment of Viola.

C. Restoration Projects Funded by Non HCP Sources

Figure 22 shows the locations of several habitat restoration and/or invasive control projects on San Bruno Mountain funded through primarily non-HCP sources in 2005. Restoration projects shown include projects being done by San Mateo County Parks with funding provided through grants from California State Parks, the California Coastal Conservancy, and the California Native Plant Society. Additional projects are being carried out by the City of Brisbane, San Bruno Mountain Watch, Friends of San Bruno Mountain, and Myers Development Corporation. Most projects are 3-5 year projects, and are still be implemented as of 2007.

Figure 19. Change in Eucalyptus Distribution on San Bruno Mountain 1983 - 2007

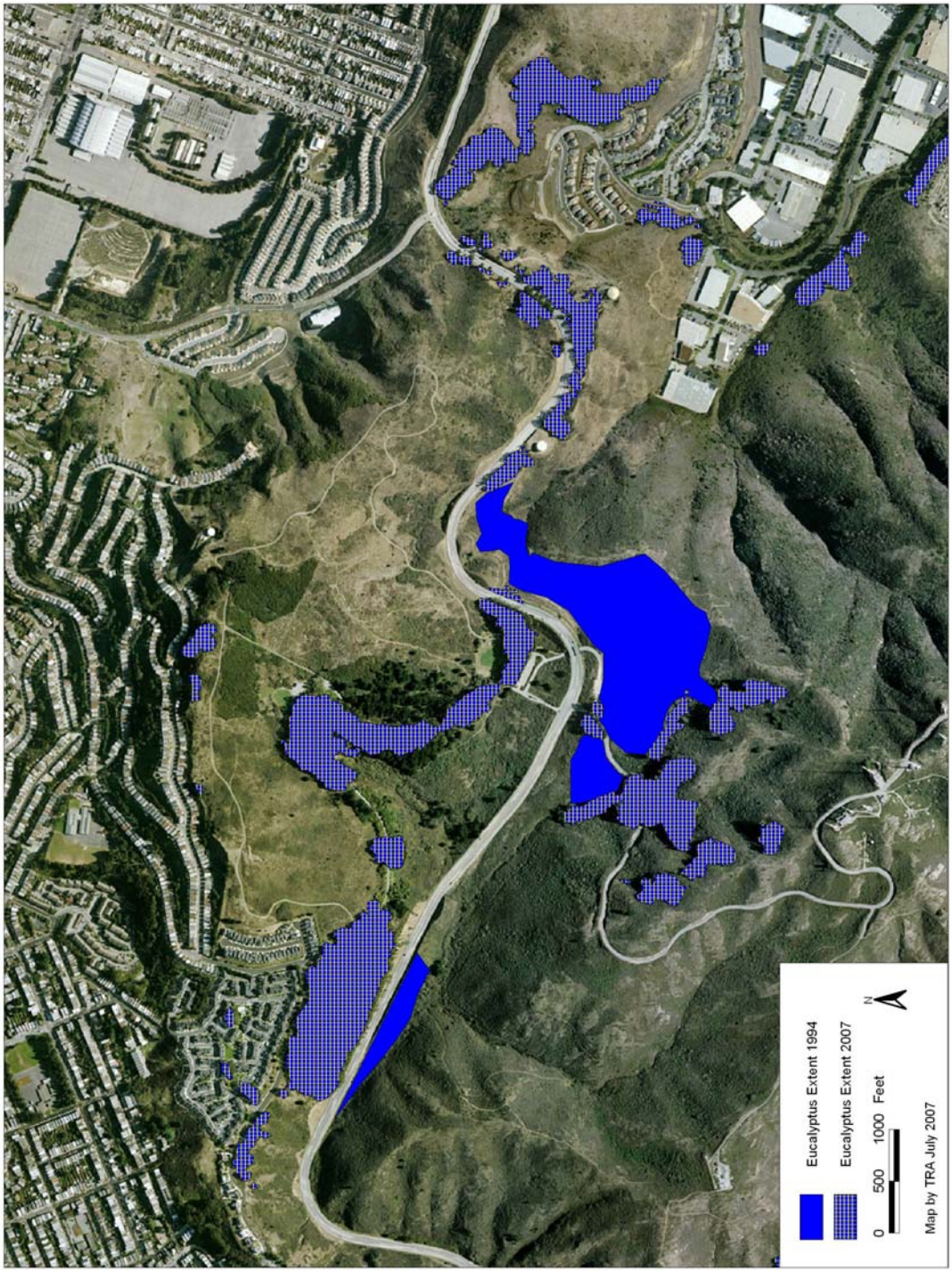


Figure 20. Southeast Ridge of San Bruno Mountain, May 2004

Flowers in background are infestations of herbaceous weeds including field mustard (*Hirschfeldia incana*) and wild radish (*Raphanus sativus*).

Figure 21. Habitat Restoration Islands on San Bruno Mountain 2007

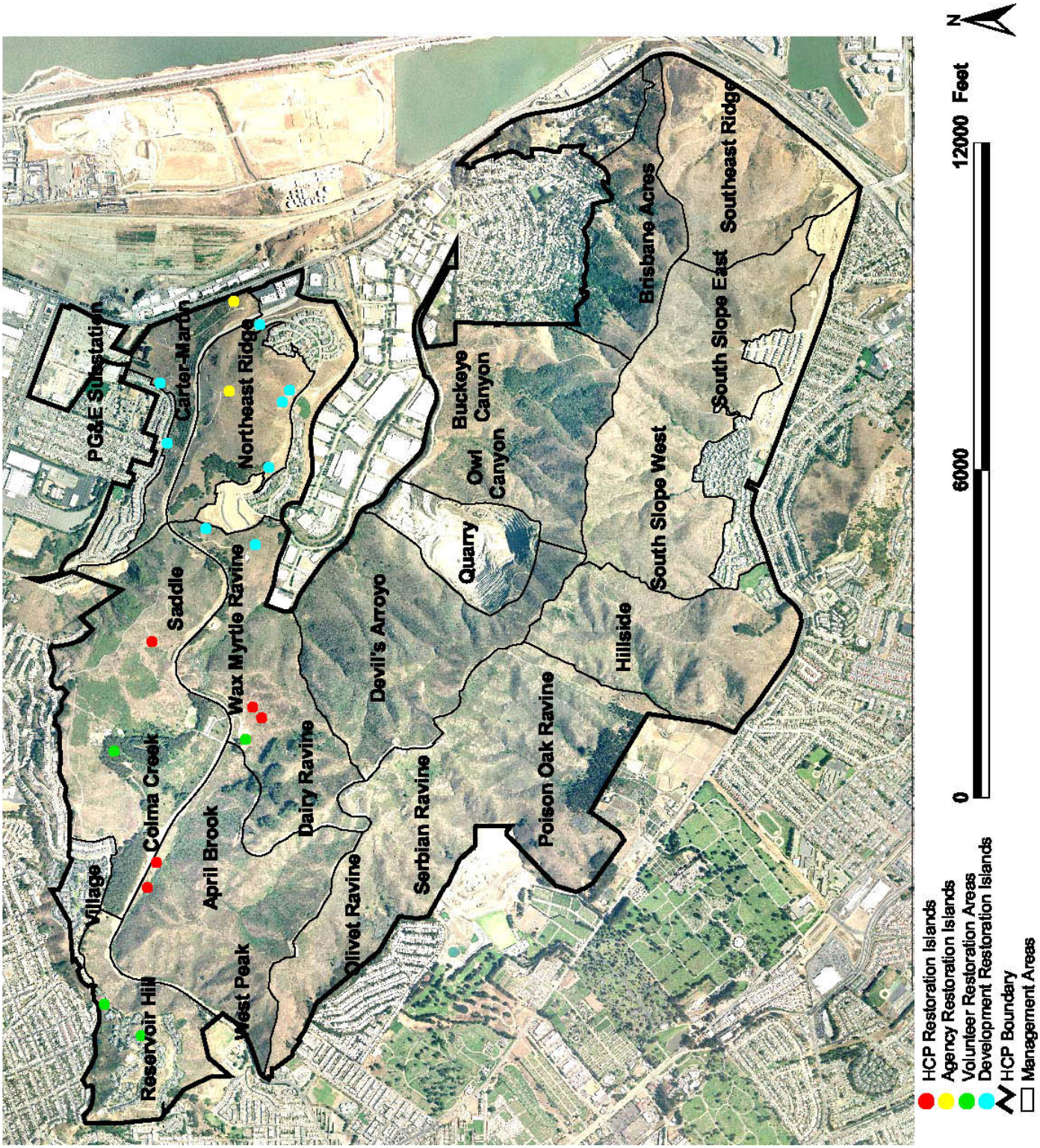
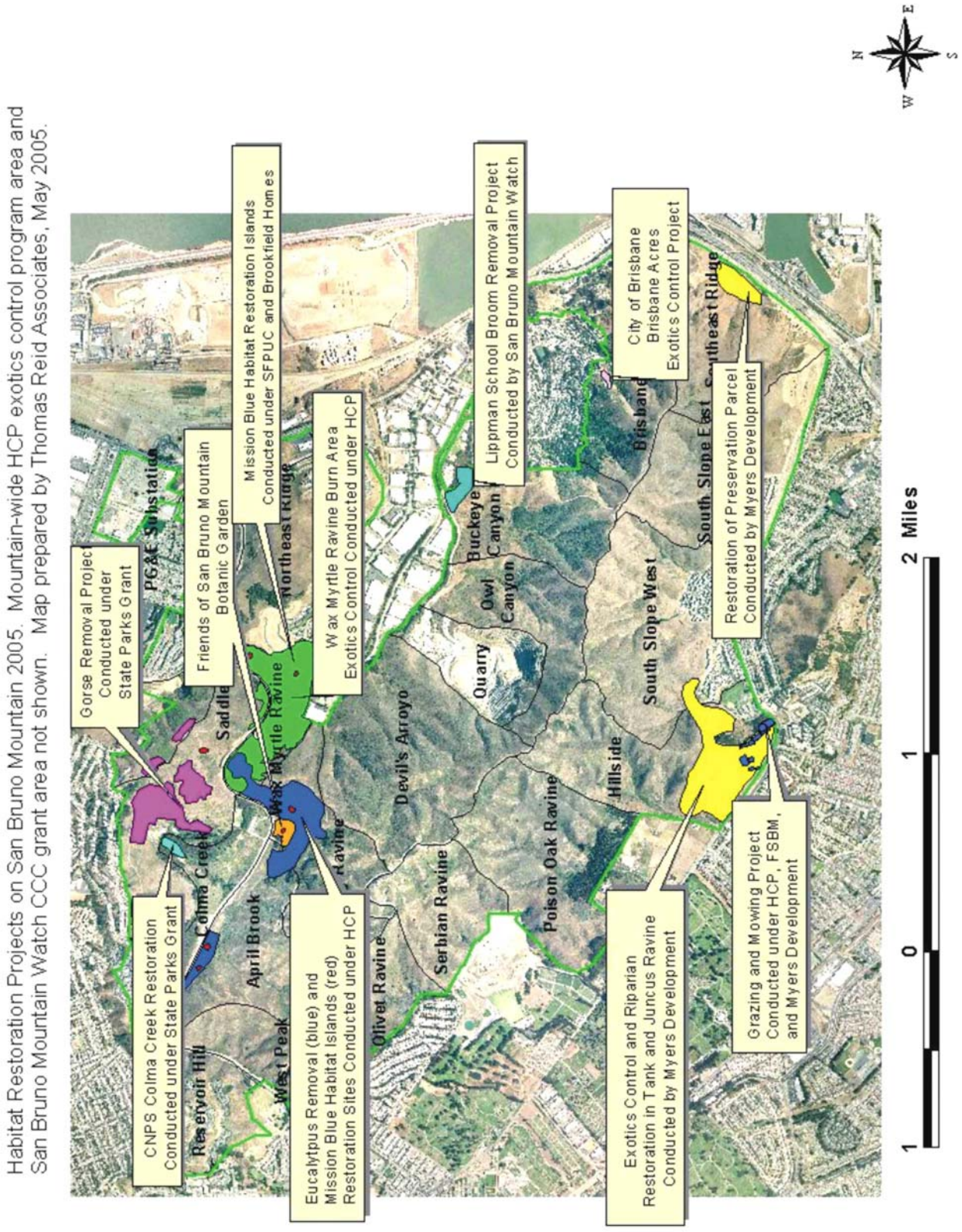


Figure 22. Habitat Restoration Projects Funded Through Primarily Non HCP Sources



D. Site Activity Permit Process

The site activity permit (SAP) process is used to review projects that are minor in scale, yet have potential to impact sensitive habitat areas within the San Bruno Mountain HCP area. The permit is not a discretionary permit, but rather a notification process by which the Habitat Manager can oversee and regulate the activities of developers, agencies, restoration contractors, researchers, volunteer groups and others who wish to conduct work on the Mountain. The SAP applies to any proposed project that is within the conserved habitat, and within areas to be dedicated as conserved habitat in the future. Examples of projects that require an SAP include vegetation control (hand pulling, mowing, chipping, pile burning) by County, City, or volunteer groups; seed collection by restoration contractors and volunteer groups; and roadway maintenance by County, PG&E, and San Francisco Water Department. To obtain an SAP, the applicant must fill out the SAP form (Appendix F) and send it to the Habitat Manager. The Habitat Manager reviews the project description, location, equipment involved and time frame, and assesses if there will be any potential impact to sensitive habitat. Sometimes a site visit is required. If it is determined that there will be no negative impact to protected habitat, the SAP is approved and the form is signed and sent back to the applicant, with a copy directed to the County. If there is the potential for impact to sensitive species, conditions are placed on the project to avoid or reduce impacts. Conditions may include monitoring, altering the timing of the project, post-project invasive species control work and/or replanting. Any project that has the potential to take a species not covered under the San Bruno Mountain HCP cannot be approved through the SAP process. The SAP does not provide coverage for activities that may impact wetlands or other sensitive habitats or species not covered by the San Bruno Mountain Habitat Conservation Plan Endangered Species 10(a) permit.

E. Roadsides, Trails, and Utility Easement Management

Throughout the HCP area there are roads, trails, and utility line easements. In some areas these areas have high concentrations of endangered species habitat along these corridors. These areas are also often the sites of weed colonization and dispersal. Management of these areas requires coordination with jurisdictional agencies including County Park Rangers, County Public Works, City and County Public Works Agencies, PG&E, CDF, San Francisco Water Department, and local fire departments. To minimize impacts to the endangered species from maintenance activities, the Habitat Manager works with agencies through the Site Activity Permit process to avoid, minimize, or replace impacted habitat.

VII. HABITAT MANAGEMENT PRIORITIES AND PRESCRIPTIONS

A. Vegetation Management Priority Areas

The Mountain has been divided into four priority categories for management purposes, as shown in Figure 1 and described below.

Priority 1: (1,292 acres)

This management area includes all core habitat for the mission blue, callippe silverspot butterfly, San Bruno elfin and bay checkerspot butterflies on San Bruno Mountain, and currently consists of approximately 30% coastal scrub, and 70% grassland. This management area has been consistently managed over the span of the HCP, though management cannot be conducted thoroughly throughout the 1292 acres on an annual basis due to limitations in funding. Management of the endangered species habitat has been accomplished within most of the unit by prioritizing management areas based on habitat value, and modifying work areas annually based on the changing distribution of invasive species.

Priority 2: (495 acres)

This management area includes less important habitat areas located on the periphery of the core habitat areas. It consists of 1) all additional grassland habitat on the Mountain that provide habitat for the mission blue, callippe silverspot, and/or bay checkerspot butterflies; and 2) all grassland areas that have converted to coastal scrub over the span of the HCP and/or provide important movement corridors for the listed butterflies.

Priority 3: (884 acres)

This management areas includes primarily dense stands of coastal scrub and woodland plant communities. It includes: 1) all additional coastal scrub habitat not within Priority 1; and 2) and all native oak woodlands and riparian areas on San Bruno Mountain. These areas are primarily located on the western half of the Mountain and on north- facing slopes where fog and/or brush communities limit occurrence of the butterflies. These areas generally do not support listed butterfly species however pockets of grassland butterfly habitat are present within some coastal scrub habitat. Coastal scrub is a plant community that depends on infrequent fire for regeneration and overall plant community health. Treatment of the coastal scrub within this unit utilizing the additional tools of grazing, mowing, and/or burning would require a significant increase in funding. Although butterfly habitat is limited within this management area (and it is therefore a lower management priority) this area would benefit from more frequent burning to maintain the health of this plant community.

Priority 4: (248 acres)

This management area has significant dense infestations of invasive species including eucalyptus forest, gorse and French broom. These infestations are expensive to eradicate and do not pose a significant threat to native habitats and/or to the butterflies of concern as long as they are controlled from spreading into Priority 1, 2, and 3 areas. Some of the Priority 4 areas could be restored to butterfly habitat and would be suitable for stand-alone restoration projects. Management of these areas and efforts to restore these areas are not a high priority use of HCP funds due to the high cost of conducting such work, and the long-term commitment required to obtain results. This Plan recommends that the control of these areas be pursued through grant

funds or other sources of funding whenever possible. For example, the gorse control project located in the central Saddle has been implemented under a Coastal Conservancy grant since 2002, and has expended $330,000 to control 49 acres of gorse over a 5-year period.

Treatment of Priority areas 1, 2, and 3 on a broad scale utilizing the tools of grazing and/or burning supplemented by hand control, herbicide, and mowing would require a significant increase in funding. Without an increase in funding, the Priority 1 management area would continue to be managed with a focus on the highest priority invasive species threats using hand control, herbicide, and mowing.

B. Habitat Management Units and Prescriptions by Unit

The HCP area has been divided into 13 habitat management units for the purpose of organizing vegetation management into a more comprehensive structure for implementing and evaluating management (Figure 23). The management units were redrawn based on vegetation boundaries, roads, trails, and previous management and monitoring boundaries. Descriptions, figures and prescriptions for the 13 management units are provided in Appendix A.

Within each management unit there are Priority 1, 2, 3, and 4 areas. If funding is limited to the current HCP funding program, all Priority 1 areas would continue to be managed within each of the management units. Priority 2, 3 and 4 areas would be added in sequence when additional funds are acquired for the management program.

Prescriptions for each unit are focused upon using a combination of techniques to reduce invasive species and reverse coastal scrub succession, as well as change the conditions that give rise to invasive species and coastal scrub succession. The primary tool to change the conditions is grazing. This approach diverges significantly from previous management approaches, which focused primarily on directly eliminating invasive species and reducing the extent of coastal scrub through the use of hand or herbicide work.

If supplemental funding is acquired, grazing will be tested for the first 3-5 years of the plan and if results show a significant benefit to the butterfly species, this tool would be expanded along with the tools of mowing, herbicide and hand control as supportive techniques. Grazing and/or mowing could also be used to provide low vegetation buffers between wildland and urban interface areas so that controlled burning may become a more reliable management tool in the future. During the experimental phase, no more than 15% of the grasslands of San Bruno Mountain (between 100 and 200 acres) would be grazed. In addition, once an effective management strategy is developed utilizing grazing, mowing, and/or burning, no more than 50% (approximately 600 acres) of the Priority 1 management area would be treated on an annual basis.

The following general prescriptions will be followed within each management unit, depending upon available funding. Until additional funding is acquired, the current management program utilizing mowing, hand and herbicide control techniques with a focus on the highest priority invasive species threats within all of the Priority 1 management areas will be continued. Exceptions and modifications are noted in the descriptions for each management unit.

a) Conduct grazing and/or mowing to reduce thatch, non-native species coverage and reverse coastal scrub succession. ;

b) Continue and expand herbicide, hand control and mowing control to reduce fennel, bristly ox-tongue, and other invasive weeds, to supplement burning and/or grazing;

c) Consider reseeding native grasses and forbs, including butterfly host plants into sites where non-natives have been dominant;

d) Use 'weed emergency fund' to control weeds on an as-needed basis after wildfires and other non-predictable disturbance events;

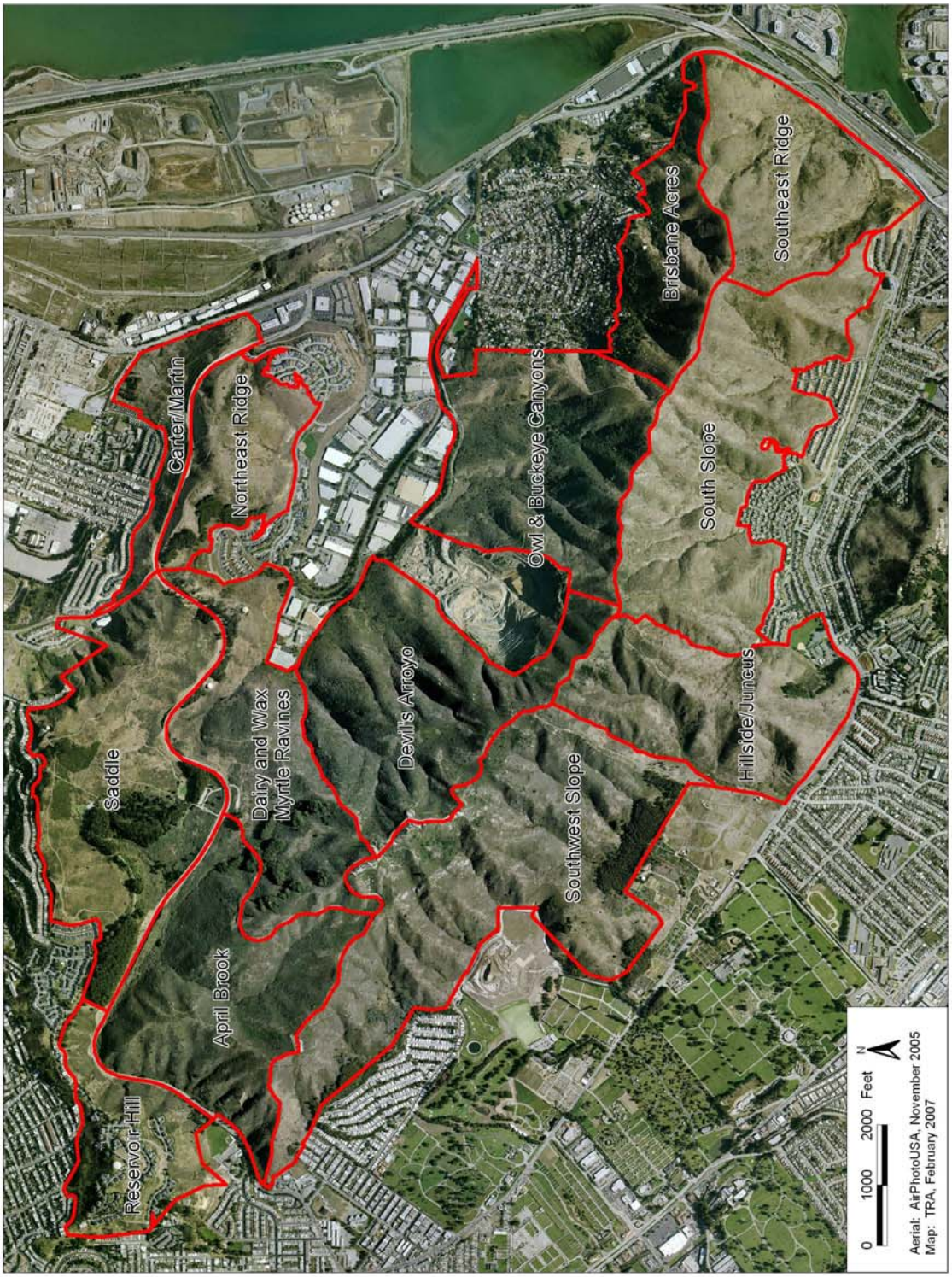
e) Coordinate with CDF to minimize and restore areas impacted during wildfire control operations.

f) Conduct brush control as needed to control coastal scrub succession, using pile burning or other methods approved and supervised by CDF.

C. Emergency Management Funds

A portion of the habitat management budget shall be set aside each year (starting at $10,000) for dealing with any emergency management needs that arise during the course of a fiscal year. This would allow for emergency steps to be taken immediately to deal with a new weed infestation or other change of condition, until the annual HCP budget can be re-prioritized at the beginning of the next fiscal year. Emergency HCP Trust meetings could also be scheduled to re-prioritize funds, when necessary. Emergency funds allocated but not used, would be rolled over to the following fiscal year.

Figure 23. Habitat Management Units on San Bruno Mountain



VIII. EFFECTIVENESS MONITORING

Effectiveness monitoring is vital to recognizing changes to the ecosystem and to gauge the results of habitat management work and the status of the butterfly populations. Effectiveness monitoring over the 25-year span of the HCP has been focused on collecting five types of data: distribution and/or the relative abundance of the endangered butterflies; distribution of rare plants; invasive species distribution; distribution of plant community types, and documentation of habitat management work. This information has been reported in the San Bruno Mountain HCP annual reports (1982 – 2006).

A. Endangered Butterfly Monitoring

Endangered Butterfly monitoring conducted over the 25-year span of the San Bruno Mountain HCP has focused on assessing the distribution (using wandering surveys from 1982- 2000) and relative abundance (using set transects from 1998 – 2007) of the federally endangered mission blue and callippe silverspot butterflies. The San Bruno elfin butterfly has been assessed through point counts of larvae and adults within representative habitat areas on the Mountain. All three butterflies have low growing host plants that can easily be overgrown by weeds and/or coastal scrub vegetation, and all three species overlap in their distribution on the Mountain.

The San Bruno elfin is primarily limited to upper elevation grasslands on north-facing slopes along the main ridge of the Mountain, whereas the callippe silverspot and mission blue are found in upper and lower elevation grasslands on a variety of slopes and exposures. The callippe silverspot is found throughout the large grassland areas of the Mountain, and is largely absent from the western and northwestern side of the Mountain (i.e. West Peak, west Saddle areas), where fog and coastal scrub are more prevalent. The mission blue is the most widely distributed of the three endangered butterflies and is found in most grassland areas, but less commonly on the northwest side of the Mountain.

Butterfly Monitoring Methods

Two monitoring systems have been used to monitor the endangered species on San Bruno Mountain over the span of the HCP: set transects and wandering transects. Wandering transects (surveyors do not follow set routes) were used from 1982 to 2001. This system provided an annual assessment of the distribution of the butterflies, but did not provide a reliable estimate of the relative abundance of the butterflies. Set transects have been used from 1998 to 2007, and were installed to provide a more robust data set for estimating relative abundance and population trends of the endangered butterflies.

Set Transects

Set transects are areas marked in the field that are walked frequently during the flight season. The transect system provides repeatable, site-specific data on butterfly presence and abundance. Set transects have been used to monitor the mission blue butterfly on San Bruno Mountain since 1998. The mission blue transects are 50 meters long and are comparable to the National Park Service's mission blue monitoring transects at Milagra Ridge and in the Marin Headlands within the Golden Gate National Recreation Area. As of 2007, the MB transects are being modified (lengthened) to increase the number of MB recorded per transect and reduce the variance recorded within individual transects.

Set transects have been used for callippe silverspot on San Bruno Mountain since 2000. The callippe silverspot transects are of variable length (470 to 2180 meters) due to the larger range of this butterfly.

For the San Bruno elfin butterfly, set points have been used rather than transects. The point system involves visiting approximately 20 points on a weekly basis during appropriate weather during the elfin's adult flight season, and visiting approximately 8 points during a 1-2 day period for larval searches after the flight season is over. For each point, a radius of 50 feet is monitored and all adult butterflies observed within a 5-minute period are recorded. Due to the high variance of this method, the San Bruno elfin monitoring now consists of monitoring the larvae of the species at points, as this is a more reliable method for year-to-year comparison. Larvae have been recorded within a 25-meter radius around set points since 2001.

For adult butterfly monitoring, each transect is monitored approximately 5 times per flight season, and once during the estimated adult life span of a single butterfly (once every 7-10 days for mission blue once every 2 weeks for callippe silverspots). All transects are surveyed during warm, calm weather conditions within 1-2 days of one another. Actual monitoring visits are not this consistent due to summertime fog and occasional cool weather days during the flight season.

For mission blue monitoring, only transect visits that had temperatures greater than or equal to 180 C and wind speeds less than or equal to 5.0 mph are used for analysis. These parameters are used to stratify the data to reduce the variability in butterfly detection from poor weather conditions. All butterflies observed outside of the mission blue or callippe silverspot transects or in the transect vicinity during travel between transects are recorded as incidental observations.

For the San Bruno elfin butterfly, approximately 20 survey points were installed in 1998. The points are monitored each year for adults during the flight season (March/April), and a subset of the points are monitored again in late spring (May) for larvae. Larval surveys are timed with a period when the larvae are most visible as they feed on the flower heads of the Sedum, typically within a 2-3 week window in May. San Bruno elfin adult and larvae counts were conducted using point counts from 1998 - 2003. Starting in 2006, SBE adult counts were eliminated due to the high level of variance, and larval counts were increased to three counts per point per season.

Wandering Transects

Wandering transects are routes that cover large areas of the Mountain and are monitored typically 1-3 times during the butterfly flight season. The wandering transects provide distribution data on the butterflies and allow monitors to check on the status of butterfly habitat in remote areas of the park.

Wandering data for the mission blue and callippe silverspot butterflies was collected annually on San Bruno Mountain from 1982 to 2001, (though between 1997 and 2001 data was not collected thoroughly, due to the transition to a set transect system in 1998). All of the wandering data has been digitized from field data sheets and Figure 6 shows the distribution of mission blue and callippe silverspot butterfly observations recorded annually on San Bruno Mountain from 1982 to 2001.

Status of Butterfly Populations

An independent review and thorough analysis of the butterfly monitoring data ('wandering' data) collected over the period of 1982-2000 was done by Travis Longcore and the GIS lab at USC in 2004. Their analysis used a system of 250-meter square cells overlayed across the HCP area within a Geographic Information System. The years after 2000 were not used in the analysis due to a lower number of 'wandering' surveys done in those years as biological monitoring was modified to a set transect design.

The analysis found that the wandering method was suboptimal for calculating relative abundance estimates, however the data could be tested for trends in butterfly occupancy. Trend analysis was applied to the 218 cells that were occupied at least once by mission blue butterfly, and the 165 cells that were occupied at least once by callippe silverspot butterfly.

The analysis concluded that for the period 1982–2000 the populations of the mission blue and callippe silverspot butterflies were stable in overall total distribution, but indicated geographic areas of concern for each, specifically the edges of the Northeast Ridge for callippe and the northwest portion of the study area for mission blue.

An analysis of the set transect data for mission blue and callippe silverspot has been done annually on the set transect data included in the San Bruno Mountain annual reports over the past seven years. Results have indicated no discernable positive or negative trend in butterfly abundance at this time, however a minimum of eight years is needed before reliable trends (if present) can be detected.

Adult and larval surveys for San Bruno elfin have been conducted on the Mountain during the 25-year span of the HCP. These surveys have been done with much more consistency and over a larger area of the Mountain since a point system was established in 1998. At that time it was thought the species could be in decline due to low counts recorded in 1996 and 1997. The results of the more recent surveys have shown that elfins continue to be present and widespread within their habitat areas, and the perceived decline in 1996 and 1997 was likely due to a lack of survey effort, rather than an actual decline in abundance.

The current butterfly monitoring program reflects recommendations made by USFWS in 2006, after receiving peer reviews on the HCP monitoring program by Steve Courtney (Courtney S., Bigger D., 2001), and Travis Longcore (Longcore, et al. 2004). The Service received peer reviews also on Travis Longcore's proposed monitoring program by Stuart Weiss and Erica Fleishman in January 2005. Based on the reviews, the Service recommended in 2006 that the current set transect monitoring system be continued, with minor modifications (i.e., lengthening) made to the mission blue transects to reduce the variance in butterfly observations and provide a smaller confidence interval for determining trends (USFWS, Biological Opinion, April 2004). These modifications were completed prior to the mission blue flight season in 2007.

The San Bruno elfin larval surveys are much more reliable for detecting the presence and abundance of this species within its habitat areas. The USFWS has recommended that larval surveys at monitoring points should continue, and adult surveys be discontinued due to the lack of sufficient numbers to perform statistical analysis (USFWS, communications Craig Aubrey). Larval surveys were conducted three times at each point beginning in 2006. (Prior to this, both adult and larval counts were conducted). The larval surveys provide greater consistency in numbers for statistical analysis, and it is recommended that a statistical power analysis be conducted to determine usefulness of this data.

Thus far data analysis of the set transect data has shown no significant trends, (either declining or increasing) for the mission blue or callippe silverspot butterfly populations (San Bruno Mountain Annual Reports, 2004, 2005, 2006, 2007). In addition, the wandering data analysis conducted by Travis Longcore (1983 –2001) concluded that the overall distribution of the butterflies was stable over the period 1982 – 2000. An analysis of the set transect data by Charlie Knight, determined that at least seven years of transect data would be required to determine trends, (if trends are occurring). Knight recommended conducting a consistent number of transect visits per year (at least five visits per transect each year of monitoring during the flight season, and that all transects are visited during appropriate flight weather within 1-2 days of each visit. This level of effort has been implemented for seven seasons for the callippe, however no significant trend has been detected. Only one season of mission blue monitoring data for lengthened transects (2007) is currently available.

The current set transect monitoring program has been identified as a reasonable monitoring program that balances cost efficiency with management decision-making needs (Weiss, 2006; Erica Fleishman; 2006). However, to provide more assurance that the program is providing useful information, it is recommended that a statistical power analysis be conducted on the callippe silverspot and mission blue transect data.

Incorporating a mission blue and callippe silverspot presence/absence monitoring program to the existing set transect design would provide distribution data of the butterflies to complement the relative abundance data provided by transect monitoring. The presence absence program would provide a distribution data set that could be compared to provide trends in occupancy for different subregions of the Mountain, similar to what the wandering data provided. Due to the high cost of conducting both a transect (relative abundance) monitoring program, and a presence/absence (distribution) monitoring program, it is recommended that a presence/absence monitoring program be developed using volunteer assistance.

The costs of the current monitoring set transect system is approximately $8,000 - $10,000 per butterfly species per year (in 2007 dollars). A presence/ absence system is expected to cost a similar amount, but may have higher initial costs to set up the program. Though a presence/absence system would require less repeated visits to the Mountain, it would require that more area of the Mountain be covered by surveyors to provide a thorough and accurate assessment of distribution.

The current monitoring program of monitoring each species using set points or transects on an every other year basis, should be considered as the minimum data requirement to assess the status of the endangered butterfly species on the Mountain. If additional funding becomes available it is recommended that this funding be used to develop and implement a presence/ absence monitoring program that would complement the current relative abundance system.

B. Rare Plant Surveys

Rare plant distribution data has been collected in GIS format within the last 5 years for all plant species on San Bruno Mountain that are listed federally, by the state, and/or CNPS List 1B species (Appendix D). This includes the manzanita colonies (all species), Diablo helianthella, San Francisco Lessingia, San Francisco spineflower, San Francisco campion (*Siliene vercunda verecunda*), and dune tansy (*Tanacetum camphoratum*). Historically reported occurrences of white-rayed pentachaeta (*Pentachaeta bellidiflora*) and San Francisco gumplant (*Grindelia hirsutula maritime*) occurrences on San Bruno Mountain have not been verified.

We recommend that GPS mapping of all the special status rare plant species should be done on a cycle of once every two years on the Mountain to track changes in distribution and monitor health of these colonies. A simplified monitoring program of counting individual plants and GPS mapping from year to year will detect any significant changes in distribution and abundance that would then trigger management.

C. Monitoring of Additional Species

California Red-legged Frog and San Francisco Garter Snake

Monitoring over the course of the HCP has focused primarily on the butterfly species of concern, with additional monitoring of rare plants. Occurrences of the federally Threatened California red-legged frog (*Rana aurora draytonii*), (CRLF) and the State and Federally Endangered San Francisco garter snake (*Thamnophis sirtalis tetrataenia*), (SFGS) were reported on San Bruno Mountain up until the early 1970's (Sean Barry, pers. comm.). However focused surveys in the 1980's and early 1990's for these species were conducted and neither species were detected. Both species require the presence of freshwater marsh, ponds, and/or still or slow moving streams with deep pools for breeding (USFWS, 2007). Freshwater marsh habitats associated with Colma Creek on the south and west sides of the Mountain, and on the east side of the Mountain within the Guadalupe Valley, likely supported both CRLF and SFGS at one time, however these habitats were destroyed by road building and urbanization prior to the formation of the Park. Current potential habitat within the HCP area exists at a few isolated freshwater pond/marsh areas in Colma Creek, the western Saddle, and at the PG&E marsh in Daly City. There have been no recorded observations of California red-legged frogs or San Francisco garter snakes on San Bruno Mountain during the 25-year span of the HCP.

Restoration work to remove eucalyptus forest and restore riparian wetland habitat within Colma Creek by the HCP Habitat Manager and by Heart of the Mountain has expanded the amount of riparian corridor by approximately 4 acres over the last 12 years. However the lack of ponds and freshwater marsh habitat on San Bruno Mountain likely prevents the potential for establishment of breeding populations of CRLF and/or SFGS at this time. If suitable breeding habitat were to be re-established for these species on San Bruno Mountain, reintroduction would likely be necessary due to the significant urbanization barriers surrounding the Mountain that inhibit natural recruitment of the animals from known breeding locations.

Bay Checkerspot Butterfly

The bay checkerspot butterfly, a federally Threatened butterfly, was observed to be present within a linear band of habitat 0.8 kilometers in length along the summit of San Bruno Mountain. This species has not been recorded on the Mountain since 1984, after a wildfire burned through its habitat.

The species was extremely limited in its distribution on San Bruno Mountain, and was once thought to be extirpated from the Mountain during a drought in 1975-1977, when no observations were made. The population rebounded to "several hundred" individuals in 1981. Surveys conducted in 1982, 1983, and 1984 found very few individuals (average of 10 per year) during an attempt to assess the population through a mark and recapture study (Thomas Reid Associates, 1985 SBM HCP Annual Report). At that time, it should be noted that it was not illegal to collect bay checkerspot butterflies. The combination of an extremely small population size, drought, wildfire, and possibly collection appears to have brought about the extirpation of bay checkerspot butterflies on the Mountain, as no individuals have been observed on San Bruno Mountain since 1984. The host plants for this species, California plantain (*Plantago*

erecta) and owl's clover (*Castilleja densiflora*) are still found within coastal prairie grasslands on San Bruno Mountain.

The USFWS designated Critical Habitat for this species on San Bruno Mountain in 2001. The acreage defined by the Service is located on the eastern half of the Mountain, and is located above the 500 foot elevation contour. Host plants for the species occur in isolated locations both within and outside of the designated Critical Habitat area on the Mountain. San Bruno Mountain represents the most northerly part of the subspecies' former range on the San Francisco peninsula and has reasonably good conditions to support the species. The San Bruno Mountain unit is considered as an essential supporting element of the San Mateo metapopulation, and a backup to the Edgewood and Jasper Ridge populations (USFWS 2001).

At the inception of the HCP, the solitary bee (*Dufourea stagei*) and the San Francisco tree lupine moth (*Grapholita edwardsiana*) were recorded on the Mountain and proposed for protective status, but were later determined to be relatively common by the USFWS.

A variety of large and medium-sized mammals have been reported within the last three years (2004-2006) on San Bruno Mountain including mountain lion (*Felis concolor*), coyote (*Canis latrans*), mule deer (*Odocoileus virginianus*) and badger (*Taxidea taxus*). In addition red foxes (*Vulpes vulpes*), a nonnative species, have colonized the Mountain within the last 2-3 years, and are apparently breeding on the Mountain based on reports from workers at the Guadalupe Quarry.

Bumblebees

Native bumblebees, important pollinators for 42 percent of flowering plant families in California, are showing a decline in the Bay Area (Kay 2003). San Francisco hosted nine species of bumblebees in the early 1900's. In 2002, Robin Thorp, an entomologist at UC Davis surveyed for bumblebees on San Bruno Mountain and found only four of the expected nine species. Quinn McFrederick, a graduate student at San Francisco State, surveyed for bumblebees on the Mountain in 2003 and 2004. He identified the same four species as did Thorp as well as a fifth species. At the 2006 Wildlife Society conference, Thorp suggested that diseases brought in by non-native bumblebees and competition from these non-natives may have eliminated some of the northern California species, including species on San Bruno Mountain (Thorp, pers. comm.).

Due to their importance as pollinators of a wide variety of native plant species, a loss of bumblebees either in diversity or abundance, could negatively impact the ecosystem on the Mountain. Bumblebees visit a greater diversity of flowers and transport more pollen on their bodies than do the non-native honeybees. Attention to research on bumblebee status in the Bay Area, and future surveys on the Mountain to assess status is recommended.

Monitoring for additional species of concern may be conducted and academic research on the Mountain is encouraged to provide this additional information. HCP monitoring funds are focused on the endangered species and their habitats, as required under the HCP permit. While monitoring is focused on the butterflies of concern and rare plants, study and management of the Mountain's overall ecosystem will benefit the listed species.

D. Monitoring of Plant Communities and Invasive Species

Vegetation types including invasive species were first mapped by TRA in 1981, as part of the biological study for the HCP. This data was compared to US Forest Service vegetation maps

from 1932 (SBM HCP Vol.1. Figure III-5), and this provided the basis for understanding the overall magnitude of the threats posed by invasive species and coastal scrub succession to the grassland habitat. During the course of the HCP, invasive species and vegetation types were mapped in 1993 and 1996 using aerial photography and ground truthing. This information was used to develop 5-year strategic plans. Since 2002 with the advent of digital ortho-photography and global positioning navigation systems (GPS), this format has been used to map the vegetation.

The methodology for tracking finer course progress on invasive species control within the HCP area has been through daily recording of individual numbers and acreages of invasive species treated by hand control, mowing, and herbicide methods. This data is summarized and reported with a map showing all areas treated in the SBM HCP Annual Reports (1982-2006).

Photo points established on the Mountain in the early 1980's have also provided a means by which to track vegetation changes on the Mountain. A system of photo points was used to track the progress of gorse control within the Saddle for several years. Though gorse is now controlled in most of these areas monitored, monitoring should continue at some of these sites to document the on-going status of the area. Currently photo points are established in several locations on the Mountain, however a systematic method of collecting photo point data needs to be established and implemented within representative areas over the entire HCP area.

Effectiveness monitoring to date has focused on evaluating large scale changes on the Mountain, and putting as much money as possible into invasive species control work. However more effort is needed to evaluate small-scale changes in vegetation composition due to the potential impact these changes may have on the species of concern and the native plant communities of San Bruno Mountain.

While the early years of effectiveness monitoring conducted through the HCP focused on the large and/or woody invasive species (gorse, pampas grass, French broom, fennel, eucalyptus), recent years have focused on tracking the extent of herbaceous species such as Bristly ox-tongue, Italian thistle, wild radish, and Bermuda buttercup. Though several of these herbaceous species were present on the Mountain for years, they appear to have increased over the past two decades, possibly due to climatic and/or soil changes occurring on the Mountain.

Evaluation of habitat areas is currently conducted on a semi-annual basis through a review of all sites by the Habitat Manager (TRA) and the subcontractors. During these meetings, strategies and methods are discussed, and changes made where necessary to maximize the protection of endangered species habitat. Because the Habitat Manager conducts the endangered species monitoring program and oversees the habitat management programs, this arrangement has allowed for direct transference of "on the ground knowledge" of the current status of endangered species habitat to the restoration/ invasives control subcontractors. This arrangement allows management to adapt to changing conditions observed on an annual or sub-annual basis within the butterfly habitat and is crucial for maximizing protection of the endangered species habitat.

Table 5 shows the methodology for monitoring effectiveness of the habitat management efforts. For monitoring the vegetation on San Bruno Mountain, at least two scales are necessary. One to track the overall changes in vegetation types occurring on the Mountain (larger course), and the second to track changes in vegetation composition within the different plant communities (finer course). To track large scale changes in vegetation, it is proposed that mapping using aerial ortho-photo interpretation and ground-truthing be continued on a 5-year rotation. To track grass and herbaceous species presence and distribution within the grasslands, institution of a monitoring design that can effectively track these changes is needed.

The specifics of the monitoring program may need to be modified based on preliminary monitoring results and the types of vegetation management programs being implemented. For instance, approval of a pilot grazing program and/or pilot brush control program may require the addition of vegetation monitoring within specific locations, and require additional types of data. The overall vegetation monitoring system will be adapted or redesigned as needed based on input from the TAC and the USFWS, with approval from the HCP Trust, to ensure that the methodology used meets the desired objectives.

Table 5. Effectiveness Monitoring Program for the San Bruno Mountain HCP Area

Sampling Area	**Monitoring Objective**	**Sampling Method**	**Sampling Unit**	**Replicates**	**Monitoring Interval**	**Data Types (*potential)**
HCP Area	Status of vegetation types	Digital aerial ortho-photo-graphy and GIS vegetation analysis	HCP Area	N/A	Once every 5 years	Vegetation Types
Represent-ative locations within a variety of habitat types	Status of vegetation composition	Quadrats/ Transects or other method	TBD	TBD	TBD	Species composition Percent cover Residual dry matter *Soil nitrogen Photo points
HCP Area	Tracking of Invasive species control and vegetation management work	Daily Data sheets and spread-sheets	Variable (depends upon invasive species patch size)		Each Workday	Control Method (*Hand/ Herbicide/ Mowing/ Grazing*) Control Type (*Herbicide type, etc*) Number of Plants Removed/ treated Estimated Density Area Treated (*GPS*)

Establishment of transects and/or quadrats for ongoing vegetation sampling and analysis is recommended. Within the core habitat area, a selection of grassland and brush sites should be chosen that represent the vegetation communities of the Mountain and these should be consistently monitored over time. Data collected should include species composition, species percent cover and residual dry matter. Other data collected could include soil nitrogen levels. Sampling within each unit should be conducted within both managed and unmanaged areas.

Recording treatment information is vital towards evaluating the effectiveness of management tools, or combinations of management tools over time. The current system of using daily record sheets to track the number of invasive species and acreage treated through hand control, herbicide and/or mowing should be continued. Additional types of management data will need to be collected including burn intensity, residual dry matter, timing and duration of treatment events, types and number of livestock, etc.

The Habitat Manager reports the results of habitat management and monitoring efforts to the HCP Trust and the US Fish and Wildlife Service on an annual basis (San Bruno Mountain HCP Annual Reports 1982 – 2006). In addition (since fall 2006) the Habitat Manager provides updates on management efforts on a quarterly basis to the San Bruno Mountain HCP TAC.

IX. STATUS REPORTS FOR HCP HABITAT MANAGEMENT

The HCP annual reports will stay consistent in content to previous years, but will switch to a biannual cycle (with USFWS and HCP Trustees approval). The format based on previous reporting, is presented below.

SUMMARY AND INTRODUCTION

1. STATUS OF SPECIES OF CONCERN

    a. Mission blue Butterfly (*Icaricia icarioides missionensis*)

    b. Callippe Silverspot Butterfly (*Speyeria callippe callippe)*

    c. San Bruno Elfin (*Callophrys mossii bayensis*)

    d. Special Status Species Butterfly Monitoring Discussions and Conclusions

    e. Bay Checkerspot Butterfly (*Euphydryas editha bayensis*

    f. San Francisco Garter Snake (*Thamnophis sirtalis tetrataenia*)

    g. California Red-legged Frog (*Rana aurora draytonii*)

    h. Plants of Concern

2. STATUS OF VEGETATION MANAGEMENT AND RESTORATION

    (Summary of Work by Management Unit)

    a. Invasives Control (hand/herbicide/mowing)

    b. Burns (pile burning, wildfire post-burn management)

    c. Grazing

    d. Restoration (Habitat Islands)

3. DEVELOPMENT ACTIVITIES

    a. Status of Development

    b. Status of Restoration Work

4. VOLUNTEER ACTIVIITIES

5. SPECIAL PROJECTS

REFERENCES AND STUDY PARTICIPANTS

X. REFERENCES

Amme, April 17, 2002. San Bruno Mountain Stewardship Grazing Plan. Prepared for Thomas Reid Associates and San Mateo County Parks Division.

Arnold, 1983**.** Ecological studies of six endangered butterflies (Lepidoptera, Lycaenidae): island biography, patch dynamics, and design of habitat preserves. Univ. of Calif. Publications in Entomology. 99:1-161.

California Department of Fish and Game. 2007. California Natural Diversity Database.

California Department of Forestry and Fire Protection. April, 2005. Draft San Bruno Mountain Community Wildfire Protection and Fire Use Plan. Prepared by California Department of Forestry and Fire Protection, San Mateo and Santa Cruz Unit and Thomas Reid Associates.

California Native Plant Society (CNPS). 2001. *Inventory of Rare and Endangered Plants of California* – sixth edition. Rare Plant Scientific Advisory Committee, David P. Tibor, Convening Editor. California Native Plant Society. Sacramento, CA.

Courtney, S. Bigger, D. Sustainable Ecosystems Institute, 2001. Review of the San Bruno Mountain Conservation Plan Monitoring Program.

East Bay Municipal Utility District (EBMUD), Range Resource Management Plan. Website accessed: July 10, 2007. http://www.ebmud.com/water_&_environment/environmental_protection/east_bay/range_resource_management_plan/rrmpsec1intro.pdf

Edwards, S. W. 1992. The Four Seasons, Journal of the Regional Parks Botanic Garden, Volume 11, Number 4. December 2002. Published by East Bay Regional Park District, Oakland California.

Hamilton, J.G., Claus Holzapfel, Bruce E. Mahall. Coexistence and interference between a native perennial grass and non-native annual grasses in California. Department of Ecology, Evolution, and Marine Biology, University of California, Santa Barbara, California, 93106, USA

Hayes, Grey F., Holl, Karen D., 2003. Cattle Grazing Impacts on Annual Forbs and Vegetation Composition of Mesic Grasslands in California. Conservation Biology 17 (6), 1694–1702.

Hickman, J.C. 1993. *The Jepson Manual: Higher Plants of California*. University of California Press. Berkeley, California.

Ishimaru, Heather. ABC-7 News, April 5, 2007. Transcript available at http://www.creeksidescience.com/files/abc7_news_bfree_5apr07.pdf

Journal Oecologia, Publisher Springer Berlin / Heidelberg, ISSN 0029-8549 (Print) 1432-1939 (Online), Issue Volume 121, Number 4 / December, 1999, DOI 10.1007/s004420050958, Pages 518-526.

Keeley, J. E., 2002. Native American impacts on fire regimes of the California coastal ranges. Journal of Biogeography, 29, 303–320. Blackwell Science Ltd. Website accessed July 8, 2007. http://www.werc.usgs.gov/seki/pdfs/jbiogeography2002.pdf

Lindzey, S. 2006. mission blue Butterfly Survey Milagra Ridge, Golden Gate National Recreation Site Stewardship Program, Golden Gate National Parks Conservancy. Building 201, Fort Mason San Francisco, CA 94123.

Longcore, T., C. S. Lam, and J. P. Wilson. 2004. Analysis of Butterfly Survey Data and Methodology from San Bruno Mountain Habitat Conservation Plan (1982- 2000). 1. Status and Trends. University of Southern California GIS Research Laboratory and Center for Sustainable Cities, Los Angeles, California.

Longcore, T. 2004. Analysis of Butterfly Survey Data and Methodology from San Bruno Mountain Habitat Conservation Plan (1982- 2000). 2. Survey Methodology. University of Southern California GIS Research Laboratory and Center for Sustainable Cities, Los Angeles, California.

McBride, J. 1974. Plant Succession in the Berkeley Hills, California. Madroño 22:317-329.

McBride, J., and H. F. Heady.1968. Invasion of Grasslands by Baccharis Pilularis. J.Range Management. 21:106-108.

McClintock, E., Reeberg, P., Knight, W. 1991. *A Flora of the San Bruno Mountains*. California Native Plant Society Press. Sacramento, CA.

Natural Lands Management Cost Analysis, 28 Case Studies, 2004. Website accessed 2/20/07. http://www.cnlm.org/cms/images/stories/cnlm_docs/management_issues/epa_case_studies.pdf

Orsak, Larry J. The Endangered mission blue Butterfly of California, Indicator of an Imperiled Natural Ecosystem. http://64.87.109.56/mountain/fauna/missionbluebutterfly.htmWebpage Adapted from San Bruno Mountain Watch Education Leaflet Series No. 7**.** http://64.87.109.56/mountain/fauna/missionbluebutterfly.htm

Peer reviews of DRAFT San Bruno Mountain 5 Year Habitat Management Plan (emails, telephone communications and memorandums from: by Dr. Alan Launer, Center for Conservation Biology at Stanford University; David Boyd, Ecologist with California State Parks; Lori Campbell, Research Wildlife Biologist with the USDA Forest Service; San Bruno Mountain Watch, Environmental Advocacy group; Craig Aubrey and Jesse Wild, US Fish and Wildlife Service.

Peer review by Weiss, S.B January 31, 2005. Review of Longcore, T. 2004. Analysis of butterfly survey data and methodology from San Bruno Mountain Habitat Conservation Plan (1982-2000). 2. Survey methodology. University of Southern California GIS Research Laboratory and Center for Sustainable Cities, Los Angeles, California.

Peer review by Fleishman, E. January 14, 2005. Review of Longcore, T. 2004. Analysis of butterfly survey data and methodology from San Bruno Mountain Habitat Conservation Plan (1982-2000). 2. Survey methodology. University of Southern California GIS Research Laboratory and Center for Sustainable Cities, Los Angeles, California.

Sawyer, J.O., Keeler-Wolf, T. 1995. *A Manual of California Vegetation*. California Native Plant Society Press. Sacramento, CA.

Soil Ecology and Restoration Group. San Diego State University. Restoration Plan for the Proposed Palos Verdes Blue Butterfly (*Glaucopsyche lygamus palosverdesensis*) Management Area at the Palos Verdes Navy Family Housing Area, San Pedro, California. http://www.sci.sdsu.edu/SERG/restorationproj/chaparraland/palosverdes/pvma.htm. Website last update February 27, 2004. Accessed May 27, 2007.

The Noxious Weed Integrated Vegetation Management (IVM) Guide – Introduction. Website accessed 1/10/2007. http://www.efn.org/~ipmpa/Noxivm.html

Thomas Reid Associates, 1982- 2007. Annual Reports for San Bruno Mountain Habitat Conservation Plan. Prepared for San Mateo County and US Fish and Wildlife Service for Endangered Species Permit PRT-2-9818. http://www.traenviro.com.

Thomas Reid Associates, March 2004. Post-Burn Restoration Plan for Wax Myrtle Ravine (Addendum to 175 Acres Enhancement Plan for San Bruno Mountain). Prepared for San Mateo County Environmental Servicies Agency, Parks and Recreation Division.

Thomas Reid Associates May 2004, Administrative Draft San Bruno Mountain, Habitat Conservation Plan**,** Volume One, Amended 2004, For Endangered Species Permit Prt-2-9818. San Mateo County Department of Environmental Management.

Thomas Reid Associates, November, 1996. San Bruno Mountain Habitat Conservation Plan, Five Year Strategic Plan, Revised Draft. Prepared for San Bruno Mountain Habitat Conservation Plan Trustees.

Thomas Reid Associates, September, 1993. Exotic Species Control Program Documentation, San Bruno Mountain Area, Habitat Conservation Area. Prepared for County of San Mateo Department of Environmental Management.

Thomas Reid Associates, November 1982. San Bruno Mountain Habitat Conservation Plan, Volumes I and II. San Bruno Mountain Habitat Conservation Plan Steering Committee Chaired by the County of San Mateo.

Thomas Reid Associates, May 1982. Endangered Species Survey San Bruno Mountain. Biological Study 1980-1981. Prepared for San Mateo County.

The Wildlife Society, 2004. Global Climate Change and Wildlife in North America. Technical Review 04-02, 2004. Page 6, Figure 3. Simulations of vegetation response by 2070-2099 to different climate change models (US Forest Service, 2004).

University California at Davis, 2002. California Guidelines for Residual Dry Matter (RDM) Management on Coastal and Foothill Annual Rangelands. Rangeland Monitoring Series, Publication 8092. University of California Davis, Division of Agriculture and Natural Resources, California Rangelands Research and Information Center.

U.S. Fish and Wildlife Service. 1984. San Bruno Elfin and mission blue Butterflies Recovery Plan. Portland, Oregon. Prepared by Endangered Species Div., Sacramento Fish & Wildlife Office, U.S. Fish & Wildlife Service

US Fish and Wildlife Service, 1997. Final Rule Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Callippe Silverspot Butterfly and the Behren's Silverspot Butterfly and Threatened Status for the Alameda Whipsnake. Federal Register: December 5, 1997, Vol 62, Number 234, page 64306-64320.

US Fish and Wildlife Service, Department of the Interior, April 30, 2001. Endangered and Threatened Wildlife and Plants; Final Determination of Critical Habitat for the Bay Checkerspot Butterfly (Euphydryas editha bayensis); Final Rule, Part II, Federal Register 50 CFR Part 17.

US Fish and Wildlife Service, Department of the Interior, June 1, 2000. Notice of Availability of a Final Addendum to the Handbook for the Habitat Conservation Planning and Incidental Take Permitting Process. Final Rule, Federal Register / Vol. 65, No. 106.

U.S. Public Interest Research Group (PIRG) and Sierra Club, Wildlife Needs Places: The State of Disappearing Species and Their Habitat, [Washington DC, 1997], 12.

USFWS, April 7 2006. Memorandum: Intra-Service Biological Opinion on the Effects of the Continued Implementation and Amendment to the San Bruno Mountain Habitat Conservation Plan. Reference no. 1-1-06-F-0937.

USFWS, 2001. Critical Habitat designation for the Bay Checkerspot Butterfly. 21456 Federal Register / Vol. 66, No. 83 / Monday, April 30, 2001 / Rules and Regulations.

USFWS, 2007. Sacramento Fish & Wildlife Office, Species Account, California red-legged frog, (Rana aurora draytonii). Website accessed 09/07/2007. http://www.fws.gov/sacramento/es/animal_spp_acct/red_legged_frog.htm

USFWS, 2007. Sacramento Fish & Wildlife Office, Species Account, San Francisco garter snake (Thamnophis sirtalis tetrataenia). Website accessed 09/07/2007. http://www.fws.gov/sacramento/es/animal_spp_acct/sf_garter_snake.htm

Weiss, S.B. 2006. Impacts of nitrogen deposition on California ecosystems and biodiversity, California Energy Commission Report. Website publication accessed on June 25, 2007. http://www.creeksidescience.com/publications.html

Weiss, S. B. 1999. Cars, Cows, and Checkerspot Butterflies: Nitrogen Deposition and Management of Nutrient-poor Grasslands for a Threatened Species. Conservation Biology 13 (6):1476-1486.

Personal Communications

Sean Barry, Herpetologist, University California at Davis, February, 2006.

Mike Forbert, Habitat Management Supervisor, West Coast Wildlands, August 2007.

Jared Lewis, Project Manager, Living Systems Land Management (goat and sheep grazing), Inc. May 2004.

Travis Longcore, Professor, University of Southern California, GIS Research Laboratory and Center for Sustainable Cities. May and June 2004, and February 2007.

Terry Palmisano, Tule Elk Program Supervisor, California Department of Fish and Game, Central Coast Region. May, 2006.

Robin Thorp, Professor, University California at Davis. February 2005.

Stuart Weiss, Phd. Grassland Ecologist, January and June, 2007.

Bill Merkle, Wildlife Ecologist, National Park Service, June 2007.

APPENDIX A

Management Units

Appendix A. Management Units

The following is a description of each of the 13 management units including a description of the topography, vegetation communities, invasive species, and rare and endangered species. A brief description of past and current land-use and management practices is also provided. Finally, conservation needs are identified and recommended management is provided. Each management unit map shows: 1) Priority management areas, 2) invasive species infestations, 3) proposed brush control areas, and 4) potential grazing areas.

1. Southeast Ridge (191 acres)

Figures 1 and 2

The Southeast Ridge is located on the far eastern edge of the Mountain and is bordered by Bayshore Boulevard and Highway 101 on the east and south, and the ridge trail on the north. The unit has expansive areas of grassland on steep slopes and narrow bands of coastal scrub and some woodland vegetation within the ravines. The lower slopes have an Indian midden site (the Preservation Parcel), and development grading has been done on the southeastern corner and eastern flat areas for the Terrabay Phase III commercial development. The grassland within this unit has infestations of French broom, fennel, and a variety of herbaceous weeds (Figure 1).

The unit has significant mission blue and callippe silverspot habitat along the upper ridgelines and on the northern slopes between Bayshore Boulevard and the ridge. Significant patches of mission blue habitat are located along the ridge trail and on fire roads, rocky outcrops and slumps within the unit. Approximately 75% of this unit is within the Priority 1 management area (Figure 2).

The lower northern slope of this unit includes the Preservation Parcel, which is an Ohlone Native American midden site. The steep slopes were used for cattle grazing

primarily in the last century. A San Francisco Water Department pipeline runs through the eastern side of the unit, and the Terrabay Phase III commercial development is currently under construction on the more gradual slopes on the southeastern side of the unit. The Southeast Ridge has very dry conditions in summer and fall, and is prone to occasional wildfires.

Resource	**Habitat Value**
Mission Blue	High
Callippe Silverspot	High
San Bruno Elfin	Not Present
Bay Checkerspot	Moderate
Native Plant Community Diversity and Dominance	Moderate

Conservation Needs and Prescription

This unit, like many grassland areas on the south side of the Mountain, has many species of grassland weeds. Many of these weeds are too ubiquitous to control using herbicide or hand control methods and require the use of burning, grazing and/or mowing. The objective for this unit is to protect existing butterfly habitat and populations through management of grasslands with grazing and control of non-natives.

The conservation prescription for the Southeast Ridge includes the following: conduct grazing to reduce thatch, non-native species coverage, and reverse coastal scrub bristly ox-tongue, and other invasive weeds as a supplement to grazing; consider reseeding native grasses and forbs, including butterfly host plants into sites where non-natives have been dominant; use the 'weed emergency fund' to control weeds on an as-needed basis after wildfires; coordinate with CDF to minimize and restore areas impacted during wildfire control operations.

Figure 1. Southeast Ridge, Invasive Species Map

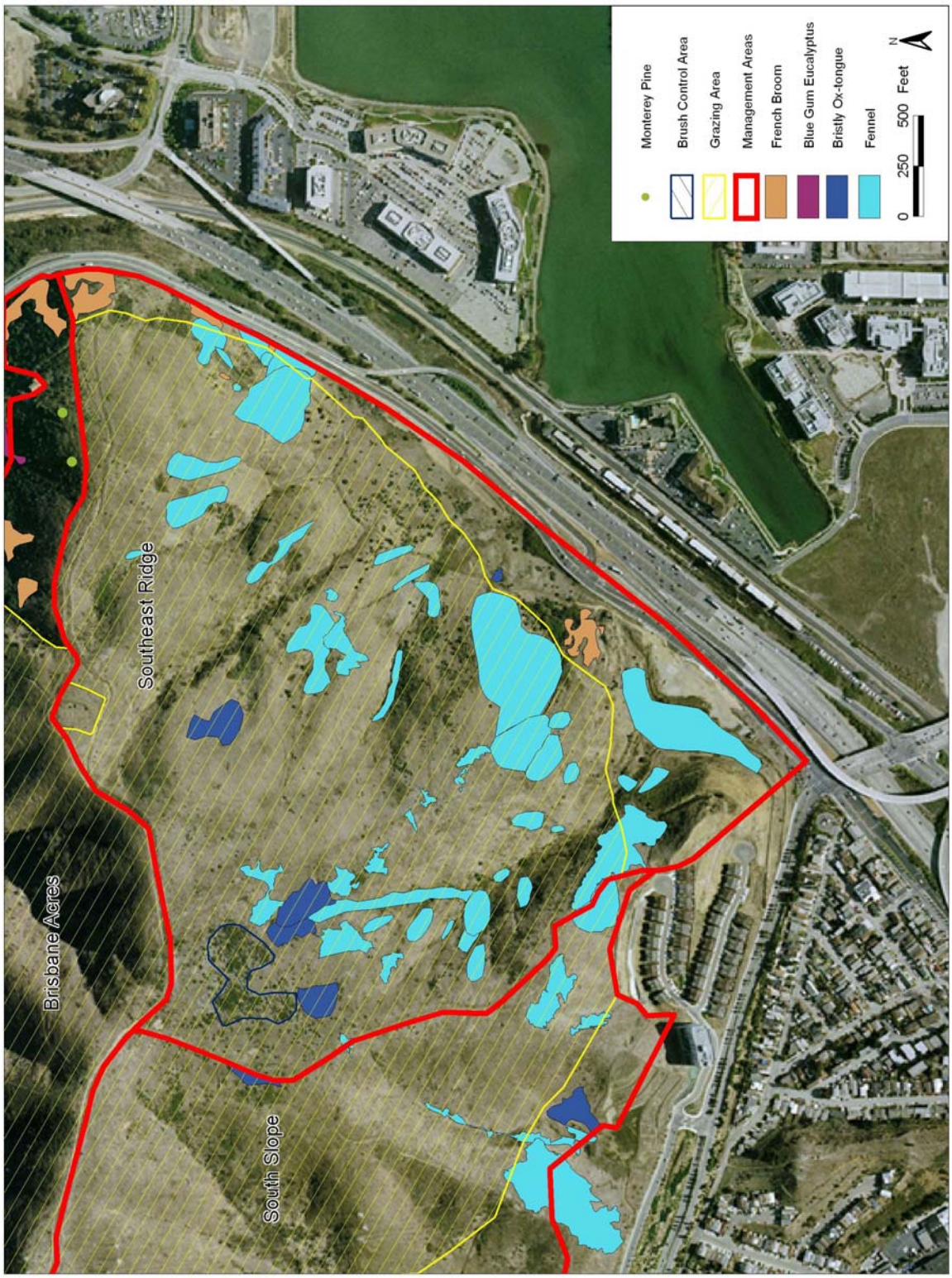


Figure 2. Southeast Ridge, Priority Management Areas

2. Brisbane Acres (190 acres)

Figures 3 and 4

The Brisbane Acres management unit is bordered by the Southeast Ridge management unit on the south side and the City of Brisbane on the north. Steep slopes, ravines and ridgelines compose a significant amount of the topography in the area. The lower northern slopes are typified by non-native Monterey cypress, Monterey pine, French broom and Eucalyptus forests interspersed with native coastal scrub and coast live oak woodland (Figure 3). Residential development rims the northern boundary of the unit. Upper ridge areas are typified by native grassland and a lesser amount of northern coastal scrub. The unit has significant mission blue and callippe silverspot habitat along the upper ridgelines. Significant patches of mission blue habitat are located along the ridge trail and on fire roads, rocky outcrops and slumps within the unit. There are a few rocky outcrops supporting Sedum spathulifolium within the unit, which may provide very marginal habitat for San Bruno elfin. A few ridgeline locations also support populations of rare plants including Diablo helianthella (CNPS 1B), and one documented location of San Francisco campion (FE). Approximately 50% of this unit is within the Priority 1 management area (Figure 4).

This management area contains high economic value in the form of private residences, infrastructure (including paved and unpaved roads, water tanks, drainage systems, etc.) and close proximity as a view-shed for the City of Brisbane. The area also contains a PG&E easement and is crossed by San Francisco Water District water supply lines.

Based on historical photography and communications with local residents, the unit was thoroughly grazed and burned during the early and middle 20th century, and grassland was the dominant plant community at that time. Since then, coastal scrub has reclaimed much of those areas. The Brisbane Acres is prone to occasional wildfires, and the most recent occurred in August 2006 and burned 38 acres.

Resource	**Habitat Value**
Mission Blue	High
Callippe Silverspot	High
San Bruno Elfin	Low
Bay Checkerspot	Moderate
Native Plant Community Diversity and Dominance	High

This management area currently has a very high fuel hazard and fire risk. The proximity of fuel loads to existing structures and residences within the Brisbane Acres area presents a serious potential threat to human life and health. These threats are in the form of Eucalyptus and Monterey cypress groves with an understory of native and non-native shrubs and trees. Large French broom stands adjacent to and within these non-native forests also represent a fire hazard.

Conservation Needs and Prescription

This unit, like other higher elevation, north facing grasslands on the Mountain, has significant stands of native grasslands and wildflowers. The objective for this unit is to protect existing butterfly habitat and populations through the management of grasslands through grazing and control of non-natives. Due to the habitat value of this unit, grazing should first be successfully tested on slopes with similar aspects and vegetation before being implemented within this unit. To reduce fire danger, methods such as manual removal and pile burning in winter are recommended to manage brush.

Figure 3. Brisbane Acres, Invasive Species Map

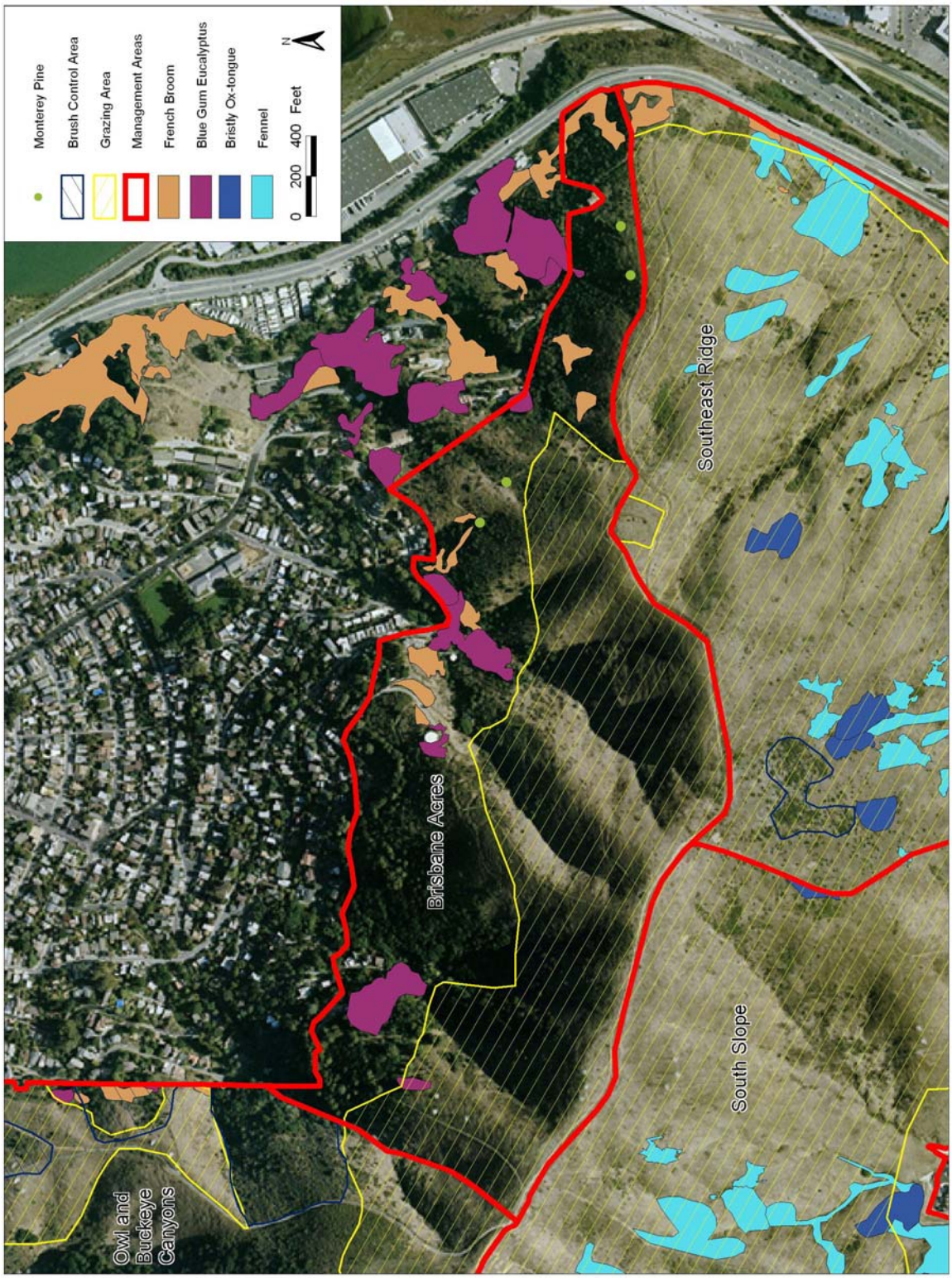
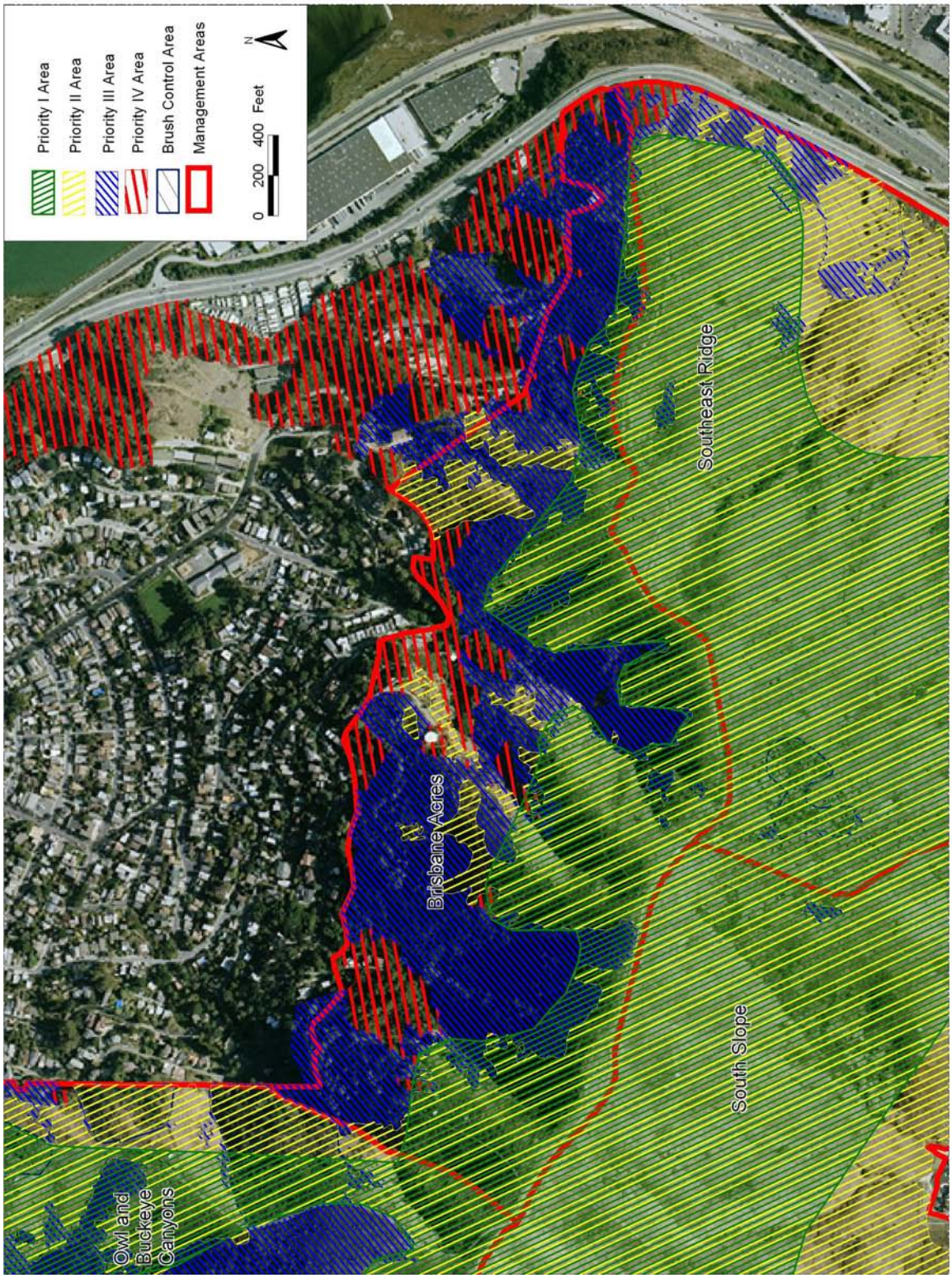


Figure 4. Brisbane Acres, Priority Management Areas



3. South Slope (477 acres)

Figures 5 and 6

This area is bordered by the ridge trail on the north and the Terrabay development on the south. The South Slope management unit is dominated by grasslands on steep, south facing slopes and ravines. Small areas of coastal scrub and with rocky intermittent drainages occur within the ravines. The Area D landslide and surrounding cut slopes created by the Terrabay development have the low quality habitat due to infestations of fennel, bristly ox-tongue, pampas grass and non-native grasses and forbs (Figure 5). Higher quality grasslands are found on undisturbed middle and upper elevation grasslands. This unit has significant callippe silverspot and mission blue habitat throughout the unit, with important habitat along the Ridge Trail. Approximately 75% of this unit is within the Priority 1 management area (Figure 6).

Resource	**Habitat Value**
Mission Blue	High
Callippe Silverspot	High
San Bruno Elfin	Not Present
Bay Checkerspot	Moderate
Native Plant Community Diversity and Dominance	High

The South Slope provides a view-shed for the City of South San Francisco. No specifically designated HCP trails are located in this area, other than the ridge trail. However, there are small foot trails and old fire trails along some of the ridges. Historically wildfire, prescribed burning and grazing have been important in maintaining this area as open grassland.

Conservation Needs and Prescription

This unit, like many grassland areas on the south side of the Mountain, needs to be grazed and/or burned more frequently to control brush and invasive species. Many of the invasive species are too ubiquitous to control using herbicide or hand control methods and require the use of grazing and/or burning. Weeds have proliferated on the Area D landslide area and adjacent cut slopes, and have radiated outward. It is important that management utilize methods such as grazing and/or burning to reduce thatch build-up and control coastal scrub expansion. Reseeding and planting with native grasses, and butterfly host and nectar plants could improve habitat quality for mission blue and callippe silverspot within the disturbed cut slope areas. Well-established fire buffer zones need to be maintained around the residential developments along the lower slopes.

Figure 5. Southslope, Invasive Species Map

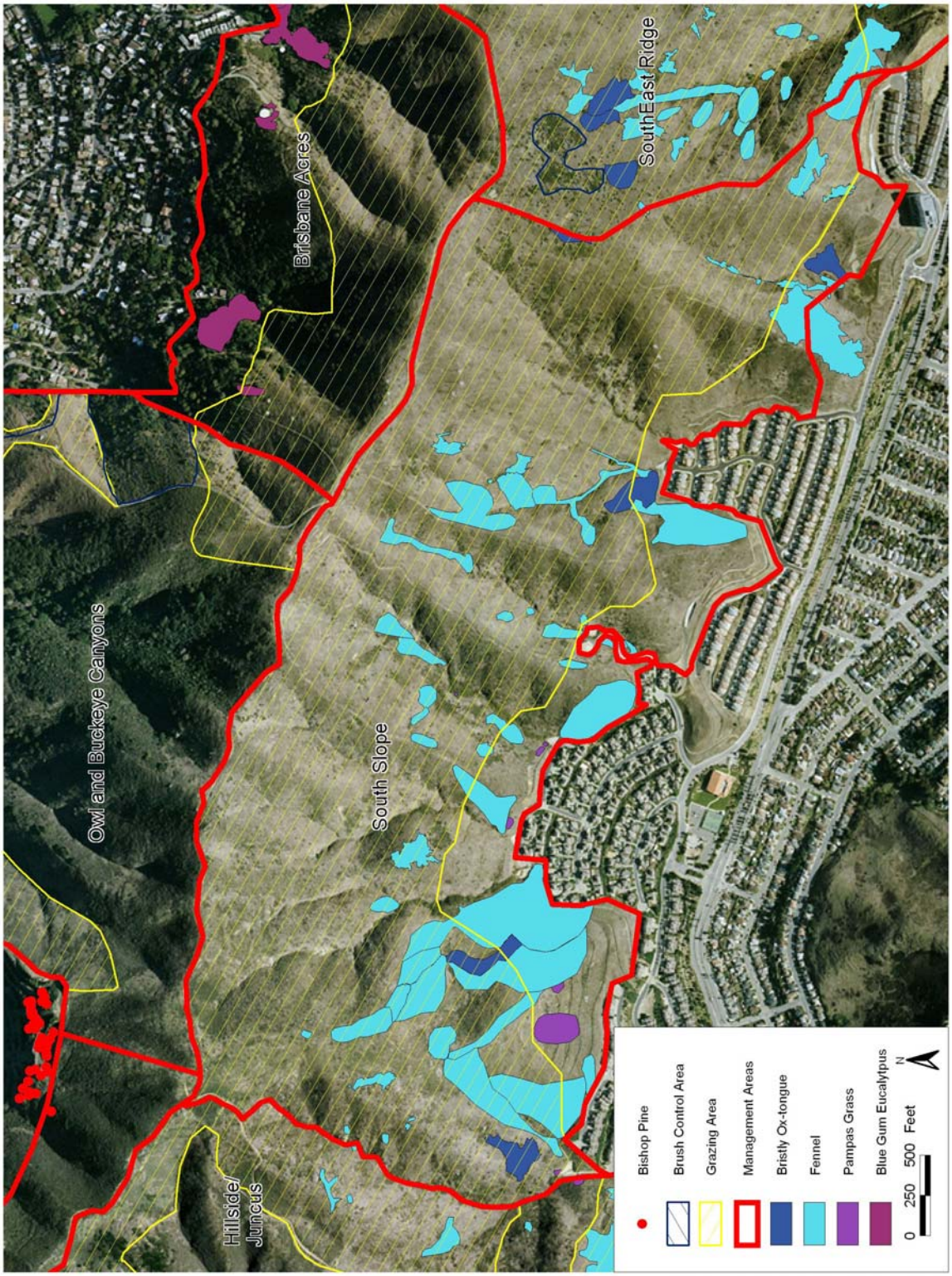
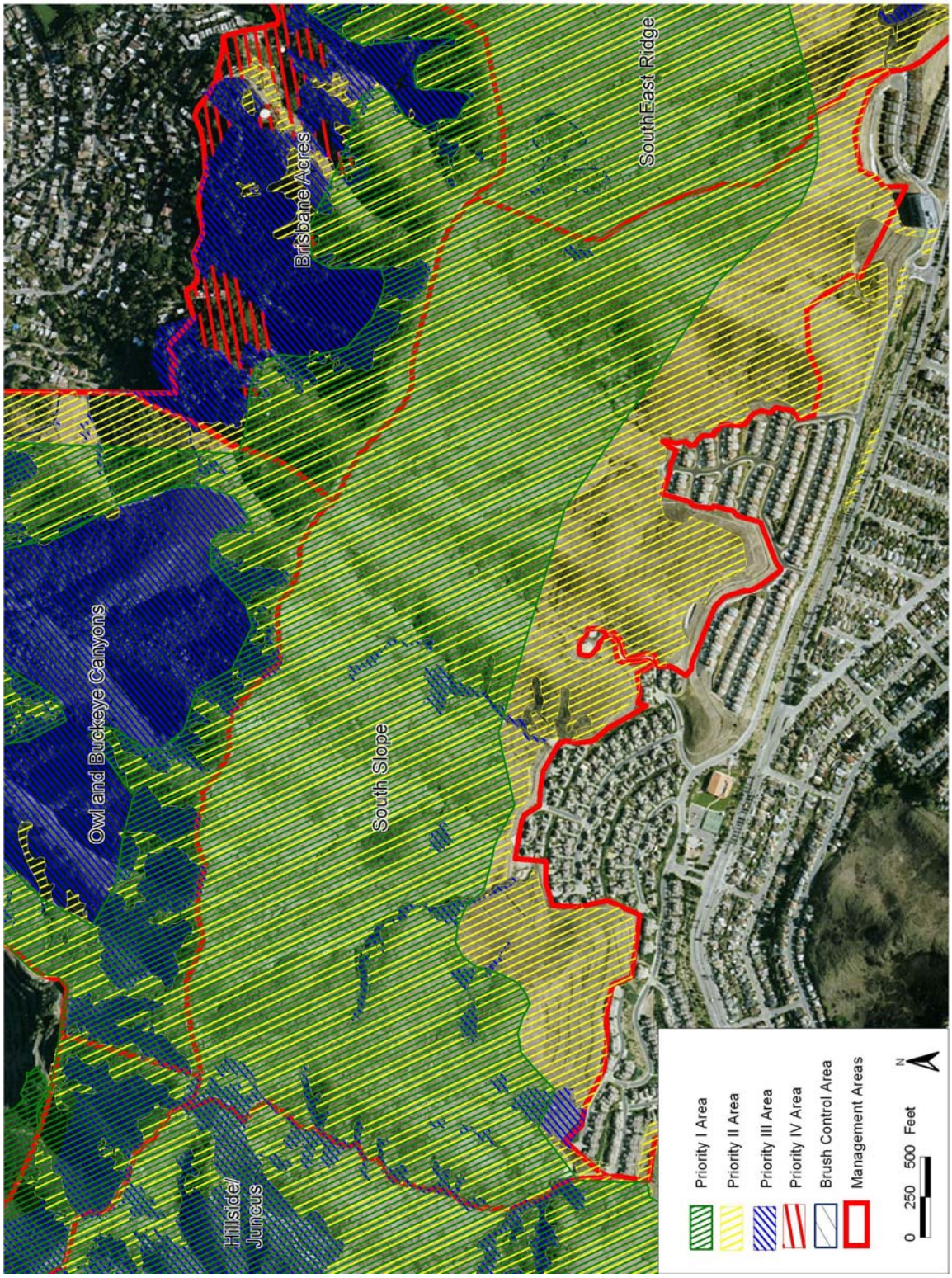


Figure 6. South Slope, Priority Management Areas



4. Owl and Buckeye Canyons (294 acres)

Figures 7 and 8

The Owl and Buckeye Canyons management unit is partially owned by the California Department of Fish and Game and is managed by the County of San Mateo. It is located along the southern and western border of the City of Brisbane. The area is characterized by steep canyons and ridgelines. Intermittent drainages are present in the larger canyons and associated ravines. Slopes are typified by native grasslands, and coastal scrub and Coast live oak woodland occupies ravines and slopes at mid-slope positions. Upper ridges are typified by native grassland and prairie communities and a significant amount of northern coastal scrub. The overall extent of invasive, non-native herbs, shrubs and trees is low due to management by volunteer groups such as San Bruno Mountain Watch and the HCP Habitat Manager (Figure 7). The canyons contain a dominance of native, undisturbed communities and some of the best recreational values due to the variety of habitats (coast live oak woodlands, riparian woodlands, seasonal marsh, and coastal scrub). This unit has high habitat value for endangered species within the grassland areas, and overall high ecological diversity. Approximately 50% of this unit is within the Priority 1 management area (Figure 8).

Resource	**Habitat Value**
Mission Blue	High
Callippe Silverspot	High
San Bruno Elfin	High
Bay Checkerspot	Moderate
Native Plant Community Diversity and Dominance	High

The Quarry Road represents one of the only developed or significantly altered areas within this unit and provides access to the quarry operations. Additionally, the PG&E transmission and gas lines pass through the eastern slope of this management area. A gravel road (Army Road) connects the Quarry Road to the Ridge Trail. Older roadcuts are found on the upper slopes on the west side of Owl Canyon, some of which provide habitat for the San Bruno elfin butterfly.

Buckeye and Owl Canyons were grazed and burned in the past, but have not burned or been grazed for over three decades. As a result, the lower slopes of the unit have converted to coastal scrub vegetation.

Conservation Needs and Prescription

A large stand of French broom occurs on the lower northeastern slopes of this management unit, and on the western boundary near the Quarry. This infestation has been largely contained, but continues to threaten the diverse grasslands and mission blue and callippe silverspot habitat. Other invasive species such as pin-cushion plant (*Scabiosa purpurea*), and annual European grasses need to be managed. Brush control and grazing may be needed to manage the native grasslands more effectively. A fire

buffer should be established and maintained along the western and northern boundary of the unit between habitat areas and the City of Brisbane.

Figure 7. Owl and Buckeye Canyons, Invasive Species Map

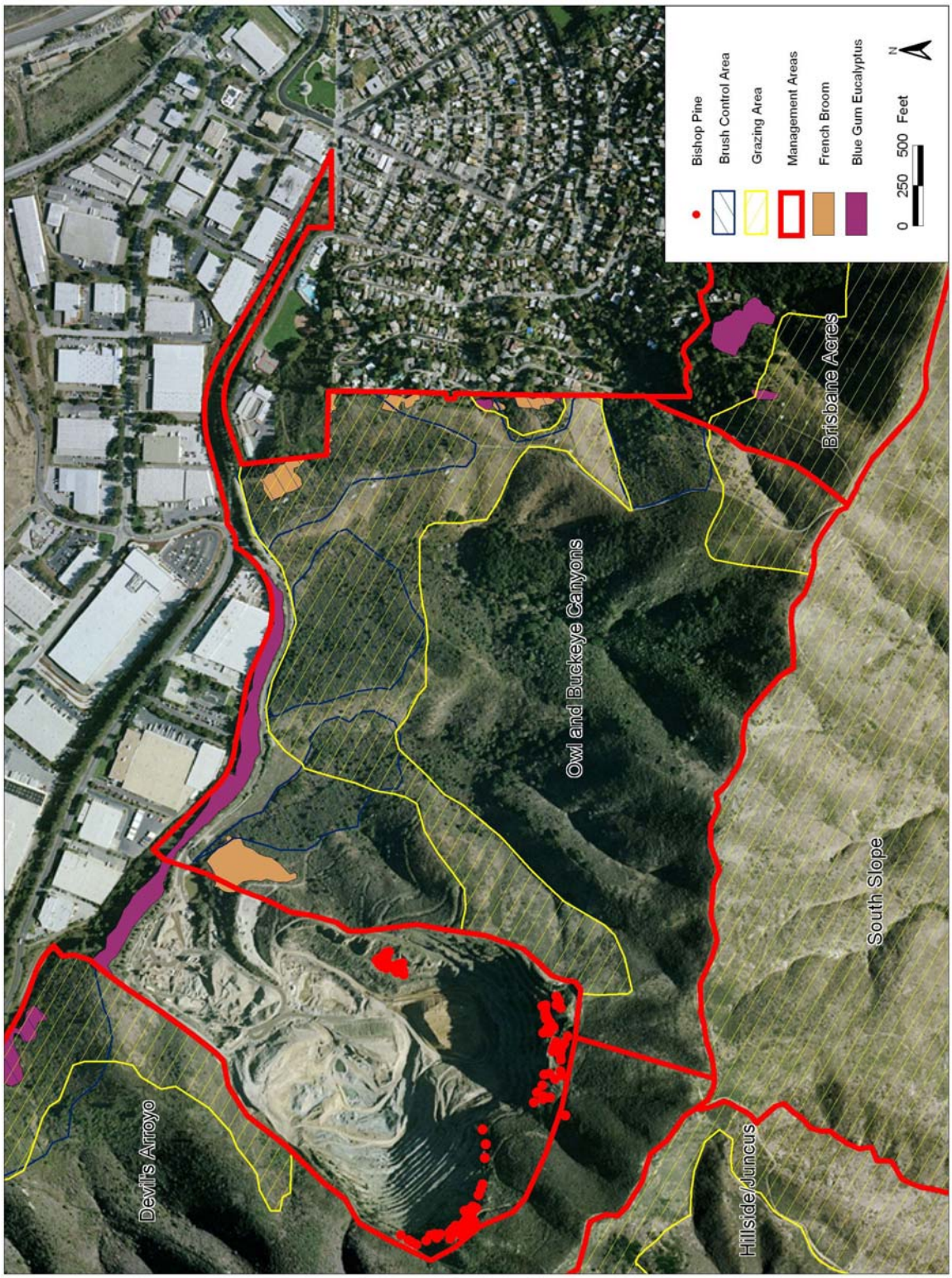
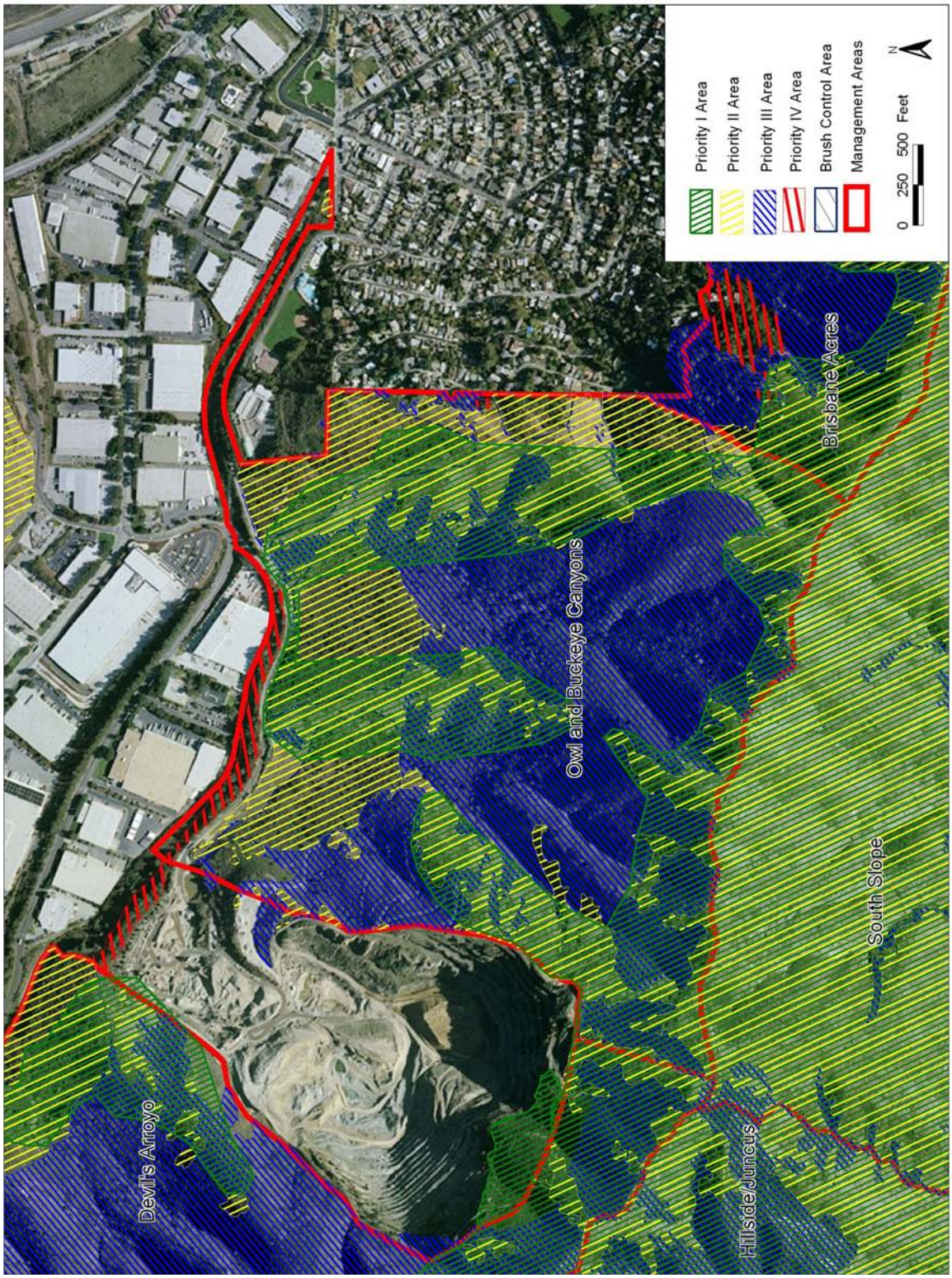


Figure 8. Owl and Buckeye Canyons, Priority Management Areas



5. Northeast Ridge (214 acres)

Figures 9 and 10

The Northeast Ridge or the Guadalupe Hills area includes rolling hillsides, terraces and slopes. It is an important habitat area for the callippe silverspot and mission blue butterflies. Grasslands are the dominant community and abundant host plants for both the callippe silverspot and mission blue are present. Plant communities include valley needlegrass grassland, blue wild rye grassland, northern coastal scrub, non-native grassland, eucalyptus forest, and broom shrublands. The grasslands are dominated by non-native annual grasses and herbaceous weeds in many areas, yet the grasslands still support the rare butterflies and their host plants in stable numbers. Approximately 80% of this unit is within the Priority 1 management area (Figure 10). Control work on French broom, eucalyptus and fennel has been effective; however non-native annual grasses and weeds such as Italian thistle and wild radish pose potential threats to the grassland (Figure 9). Eucalyptus groves on the west side are a potential fire risk.

Resource	**Habitat Value**
Mission Blue	High
Callippe Silverspot	High
San Bruno Elfin	Not Present
Bay Checkerspot	Low
Native Plant Community Diversity and Dominance	Low

PG&E transmission lines run northeast to southwest across the ridge. The Ridge development is located on Mission Blue Drive spanning the entire southern boundary of the conserved habitat. The Northeast Ridge supports several trails that are well used by the public and therefore provide recreational value.

Conservation Needs and Prescription

With both mission blue and callippe silverspot abundant on the Northeast Ridge, the greatest conservation need is the restoration and maintenance of grassland habitat. Grazing and burning are two processes that, as is common with the whole of the Mountain, were vital for the maintenance of the Northeast Ridge grassland habitat. In the absence of these processes, exotics and scrub have proliferated. To manage unwanted vegetation, the Northeast Ridge would likely benefit from a cattle grazing program. Areas for restoration and maintenance should be prioritized by butterfly host plant densities. Also, more habitat islands could be created on the Northeast Ridge, such as has occurred on the graded slopes as mitigation by Brookfield Homes. Follow-up herbicide and hand control will be crucial to maintaining areas cleared by grazing from returning to weeds.

6. Carter-Martin (129 acres)

Figures 9 and 10

These rolling hills and steeper slopes have similar topography to the Northeast Ridge management area. The Brisbane Technology Park and Bayshore Boulevard form the southeast border of this management area, while the Guadalupe Canyon Parkway forms the southwestern border. These slopes range from north to south facing, but have predominately northeastern exposure.

Plant communities include northern coastal scrub, valley wild rye grassland, non-native grassland, broom shrubland, and eucalyptus forest. Grassland communities dominate the most acreage within the unit. Though pockets of grassland enriched with a high percentage of native grasses and forbs occur in the area, there is a prominence of grasslands dominated by non-native annual grasses and other invasive herbs and shrubs. The slopes above the Bay Ridge development on the west are exclusively dominated by thick stands of gorse, while the slopes above the Bay Vista and Linda Vista developments are a mixture of native and non-native scrub (French broom) along with non-native herbaceous infestations including oxalis, pampas grass and fennel (Figure 9). The unit has moderate habitat value for mission blue and callippe silverspot. Areas of restoration (planting islands) are present and providing mission blue habitat within this management unit. Approximately 40% of this unit is within the Priority 1 management area (Figure 10).

Resource	**Habitat Value**
Mission Blue	Moderate
Callippe Silverspot	Moderate
San Bruno Elfin	Not Present
Bay Checkerspot	Low
Native Plant Community Diversity and Dominance	Low

Infrastructure within this management area includes the S.F. Water District lines and easements, and the PG&E transmission lines. Developments and residences include the Brisbane Technology Park, and three residential complexes: Bay Ridge, Bay Vista and Linda Vista. The Carter-Martin management unit provides an open space for hiking and outdoor recreation for the residents of the HCP developments. However, usage does not appear to be significant and there are no designated roads or trails, aside from the S.F. Water Districts access roads.

Dense gorse and broom stands represent significant fuel loads and are mixed with native coastal scrub in places. This mixture of native and non-native scrub is especially prominent on the slopes above Bay Vista and Linda Vista, while the slopes above Bay Ridge are almost exclusively dominated by gorse. Maintaining a minimum 30-foot fuel-free buffer zone around all residences/fence lines and infrastructure is essential for reduction of fire risk to homeowners.

Conservation Needs and Prescription

A high priority for this area is reversing the establishment of gorse, broom and coastal scrub. This management area has connectivity to other Northeast Ridge grasslands and has a high density of endangered butterfly habitat and butterfly populations. Restoring and maintaining a dominance of grassland communities is essential for this area.

Much of the land in this unit is in the ownership of private landowners and developers, and is to be dedicated to the County as conserved habitat once the lands have been restored to a suitable condition for acceptance. Management of vegetation may include scrub removal and pile burning by CDF crews and goat grazing to reduce the density and extent of heavy non-native brush cover and native scrub. In addition, regular treatments of non-native plant infestations with herbicide and manual removal will be needed. Continuing the establishment of butterfly habitat islands and localized restoration projects is also important.

Figure 9. Northeast Ridge and Carter/ Martin, Invasive Species Map

Figure 10. Northeast Ridge and Carter/ Martin, Priority Management Areas

7. Hillside/ Juncus (217 acres)

Figures 11 and 12

The parcel west of Hillside School is a combination of areas of low quality habitat adjacent to Pacific Nursery and Holy Cross Church coupled with steeper, rocky ravines and slopes (Juncus Ravine and Tank Ravine). There are PG&E Transmission lines through Tank Ravine. Plant communities include northern coastal scrub, coastal terrace prairie, valley needlegrass grassland, central coast riparian scrub, valley wild rye grassland non-native grassland, and eucalyptus forest. Fennel infestations have spread throughout the lower slopes in Tank and Juncus Ravines, and Bermuda buttercup (*Oxalis pes-caprae*) has moved upslope into grasslands from the Pacific Nursery (Figure 11). The habitat value is high for mission blue butterflies and moderate for callippes. Eucalyptus groves are a fire hazard near the school due to the explosiveness of the oils in the trees and the strong westerly winds that frequent this area. Approximately 80% of this unit is within the Priority 1 management area (Figure 12).

The parcel has received extensive control work primarily on fennel in recent years funded by Myer's development and the HCP. A pilot grazing experiment was initiated on the lower slopes in 2003 and focused treatment of Oxalis was performed in 2005 and 2006.

Resource	**Habitat Value**
Mission Blue	High
Callippe Silverspot	Moderate
San Bruno Elfin	Low
Bay Checkerspot	Moderate
Native Plant Community Diversity and Dominance	Moderate

This management area receives moderate public use. A network of roads and trails favor outdoor recreation hiking, photography, and picnics.

Conservation Needs and Prescription

Conservation needs include the reduction of scrub communities, continued monitoring and control of oxalis, fennel and other non-natives, and the maintenance of diverse native grasslands. It is recommended that a buffer area be established between Pacific Nursery and HCP lands to help control the introduction of non-native vegetation.

Figure 11. Hillside/ Juncus, Invasive Species Map

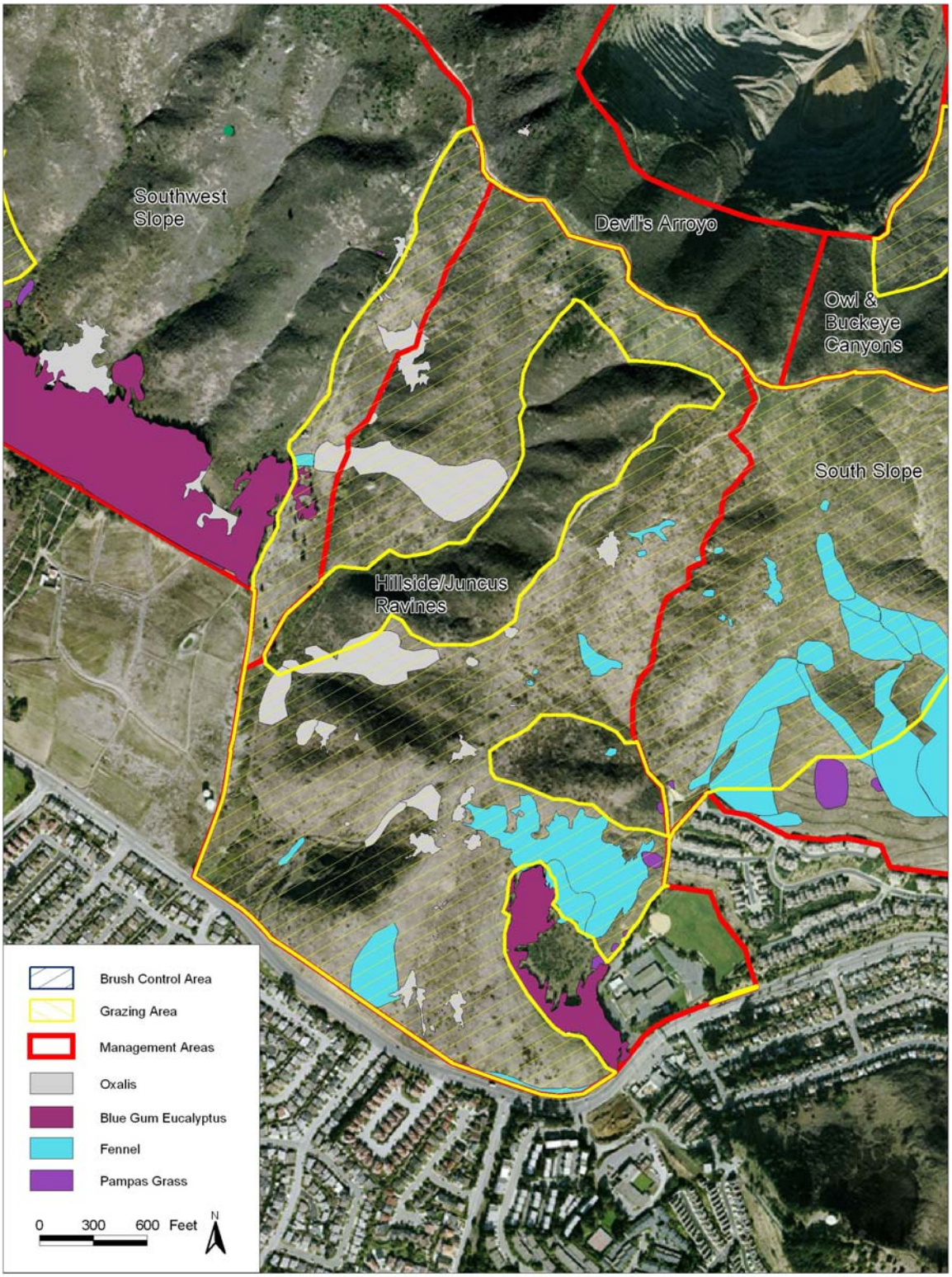
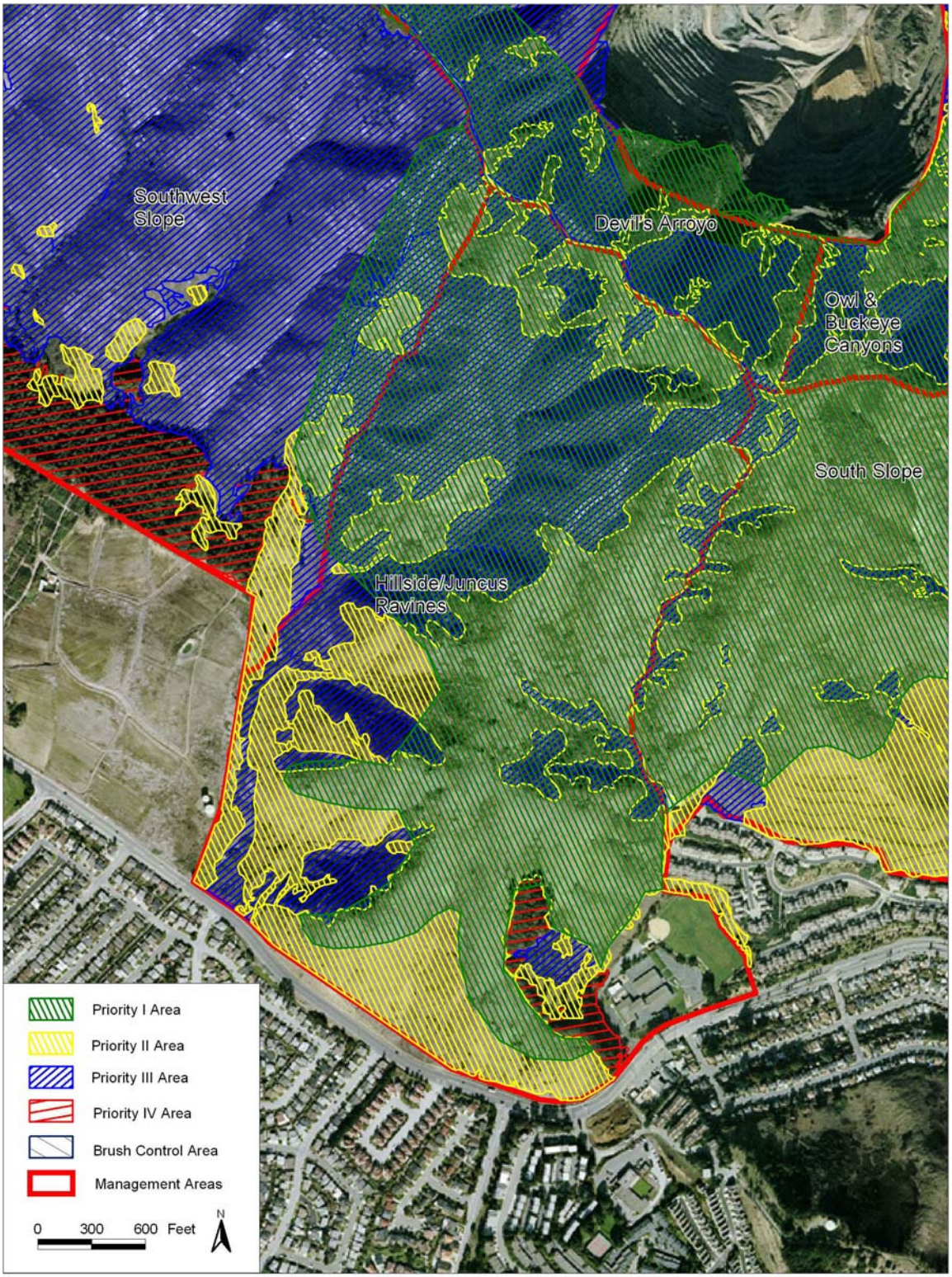


Figure 12. Hillside/Juncus, Priority Management Areas



8. Devil's Arroyo (268 acres)

Figures 13 and 14

Devil's Arroyo represents an area of large expansive slopes covered mostly by dense coastal scrub. Steep north-facing slopes and ravines extend from the base of the slope near the Brisbane Industrial Park to the Summit Trail. Plant communities include blue blossom chaparral, northern coastal scrub, coastal terrace prairie, valley needlegrass grassland, central coast riparian scrub, eucalyptus forest, broom shrubland, and non-native grassland. Relatively small yet botanically diverse grassland patches are found on ridgelines and balds on the upper slopes of this unit. The habitat value is high for San Bruno elfin butterflies, and moderate for mission blue and callippe silverspot butterflies. Manzanita Dike, the largest colony of San Bruno manzanita (CE, CNPS 1B) is found in Devil's Arroyo. Montara manzanita (CNPS 1B) is also found within this management unit. The Summit Trail forms the southern boundary, the Guadalupe Valley Quarry forms the eastern boundary, the Brisbane Industrial Park the northern boundary, and the eastern ridgeline adjacent to Dairy Ravine forms the western boundary. The upper slopes of this unit are mostly pristine, while the lower slopes have non-native infestations emanating from disturbed areas around the industrial park (Figure 13). High fuel loads are present in this area from build-up of dense scrub communities coupled with steep inaccessible slopes. The last burn event that occurred in this unit was in 1964. Approximately 40% of this unit is within the Priority 1 management area (Figure 14).

Resource	**Habitat Value**
Mission Blue	Moderate
Callippe Silverspot	Moderate
San Bruno Elfin	High
Bay Checkerspot	Moderate
Native Plant Community Diversity and Dominance	High

This unit was likely grazed and burned in the past, and supported a greater extent of grassland that it has currently. No structures or development is within this unit, except for PG&E Transmission and gas lines which extend in a north south direction through the unit. Although Devil's Arroyo provides dramatic views of coastal prairies and shrublands there are no maintained trails through this unit, except for the ridge trail along the southern boundary.

Conservation Needs and Prescription

Maintaining stands of native grasslands and conserving the endemic manzanita species should be focus of this area, in addition to maintaining healthy stands of blue blossom chaparral. Senescent stands of chaparral are ubiquitous through this unit. Blue blossom, a fire-dependent plant species, needs to burn in a hot fire approximately every 25-35 years in order to germinate and recruit new stands to replace old and decaying shrubs.

Figure 13. Devil's Arroyo, Invasive Species Map

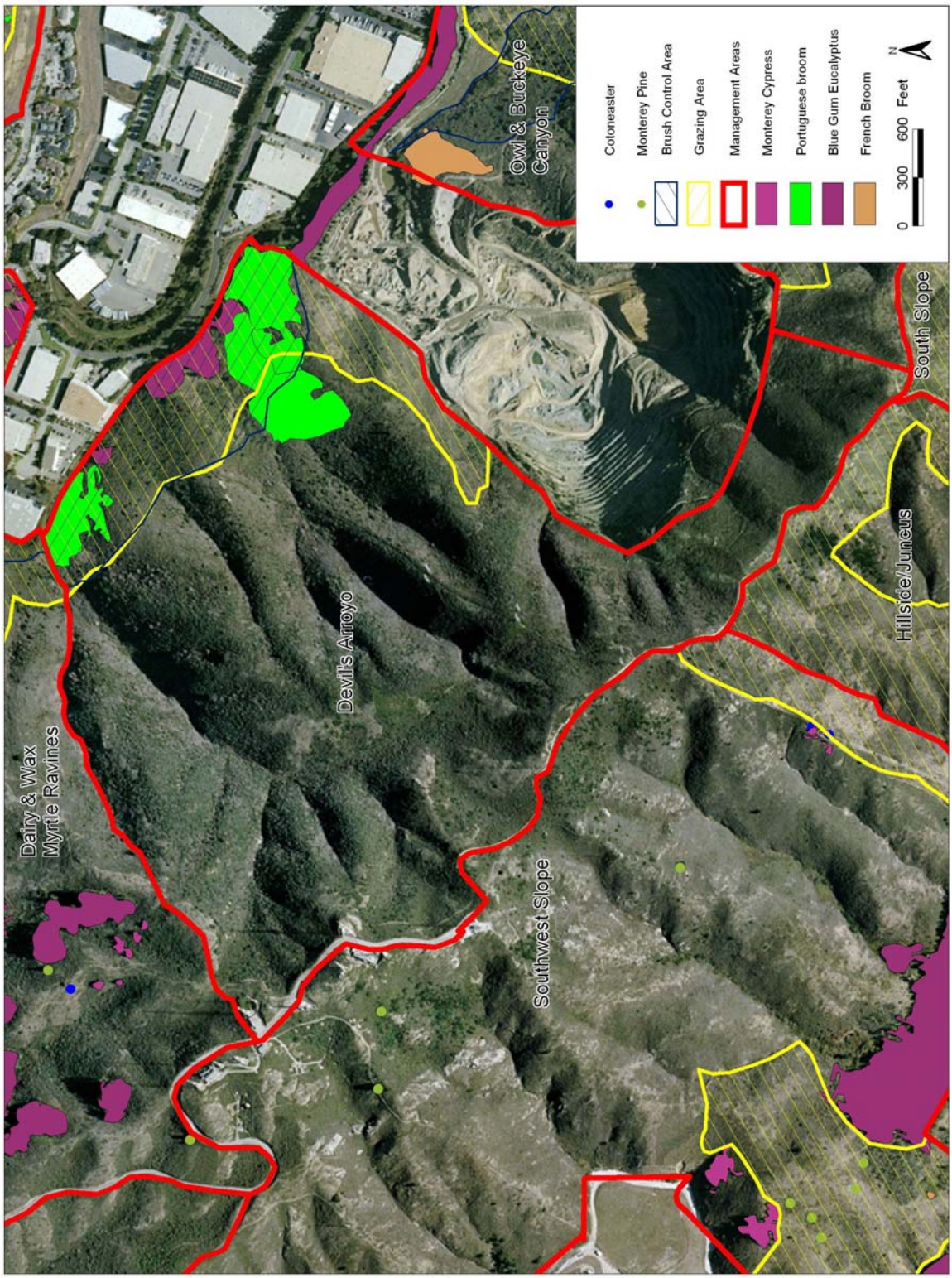
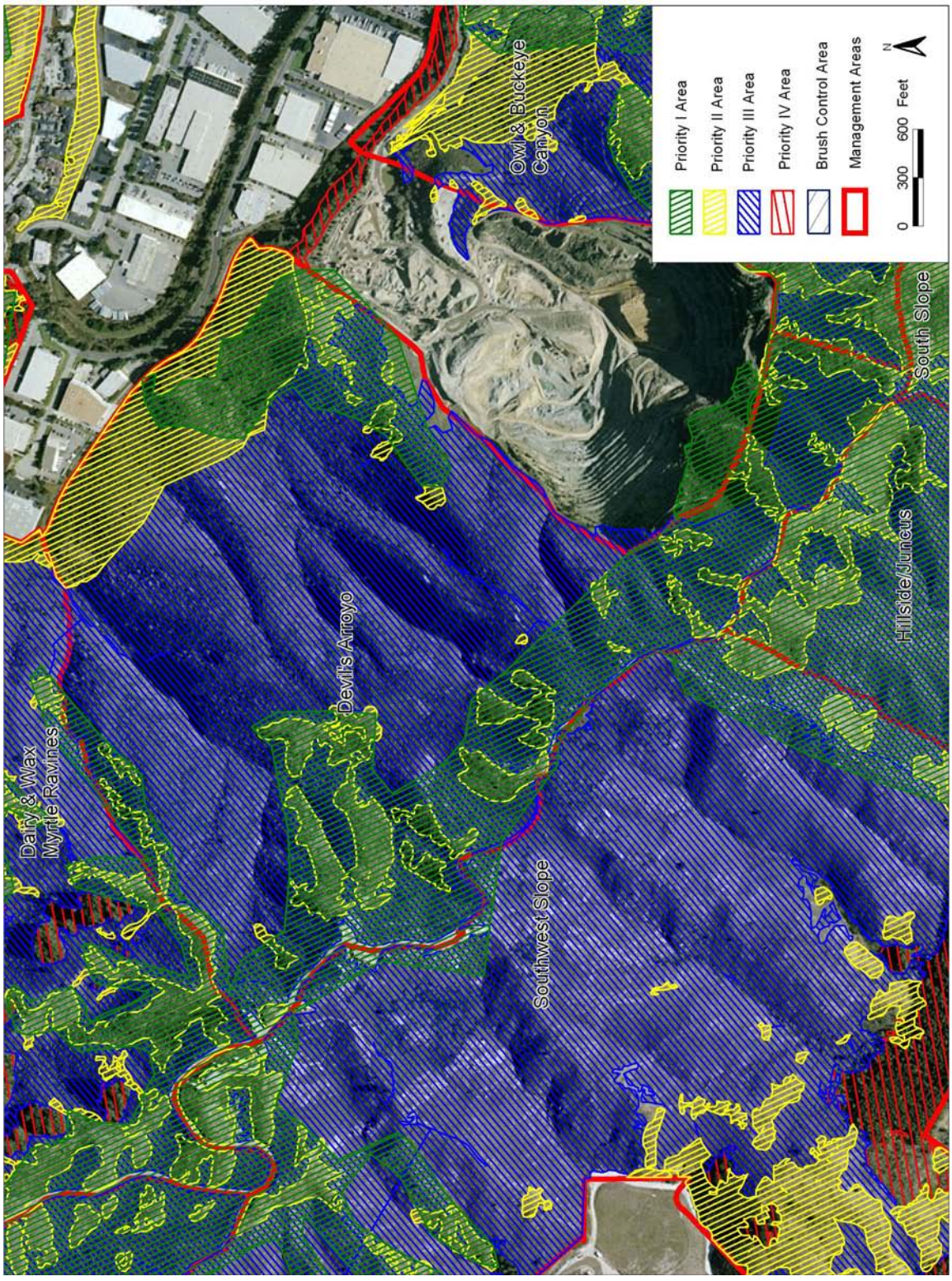


Figure 14. Devil's Arroyo, Priority Management Areas



9. Dairy and Wax Myrtle Ravines (214 acres)

Figures 15 and 16

Dairy and Wax Myrtle Ravines have a combination of high quality native habitats and disturbed restoration areas. Most of the parcel is owned by the County of San Mateo, with lower elevation portions of the unit owned by McKesson, Inc, and Brookfield Homes. The unit consists of steep slopes that extend from the Brisbane Industrial Park along Guadalupe Canyon to the summit of the Mountain and includes a variety of vegetation types and slope exposures, with coastal scrub being the dominant plant community (Figure 15). Radio Road forms the northern and western boundary of this unit, Devil's Arroyo and the city of Brisbane form the eastern boundary, and Guadalupe Canyon Parkway forms the southern boundary. The Friends of San Bruno Mountain established a native plant 'Botanic Garden' area on the south side of Radio Road within this unit. Over 30 acres of the site was logged in 1995, and restoration work has been focused on returning this area to native habitats. Important habitat for mission blue, callippe silverspot, and San Bruno elfin is found in this unit. Approximately 50% of this unit is within the Priority 1 management area (Figure 16).

The Botanical Garden area receives a significant amount of visitor usage in the form of docent-led hikes, visits from local school children and regular use by local outdoor enthusiasts. The area contains the Eucalyptus Loop Trail, and the Dairy Ravine Trail. On the north side of the ravine is Old Ranch Road, which was the original road that traversed the Mountain before Guadalupe Canyon Parkway was built in the 1960's. The Road was used to move cattle between Dairy Ravine on the top of the slope down to a Dairy located at the western end of the Brisbane Industrial Park. Two City of Brisbane Water Tanks (upper and lower) are located on the north side of the ravine, and PG&E transmission lines cross over the lower slopes adjacent to the Ridge development.

Resource	**Habitat Value**
Mission Blue	Moderate
Callippe Silverspot	Moderate
San Bruno Elfin	High
Bay Checkerspot	Low
Native Plant Community Diversity and Dominance	Moderate

The grasslands on the north side of Wax Myrtle Ravine have the highest densities of mission blue and callippe silverspot host plants and populations in this unit. The unit has high quality San Bruno elfin habitat located near nine-fern rock and within upper Dairy Ravine. A controlled burn that escaped fire lines resulted in a wildfire that burned 72.5 acres of this unit in July 2003. The burn has significantly improved the condition of this management unit by removing dense stands of gorse and eucalyptus slash, which has provided access into the ravine for restoration crews.

Conservation Needs and Prescription

Expand butterfly habitat through brush control and grazing on the lower elevation slopes surrounding the Brisbane Industrial Park and in other areas as determined. Continue control of eucalyptus, gorse, Himalayan blackberry, poison hemlock, oxalis and other weeds throughout the unit.

Figure 15. Dairy and Wax Myrtle Ravines, Invasive Species Map

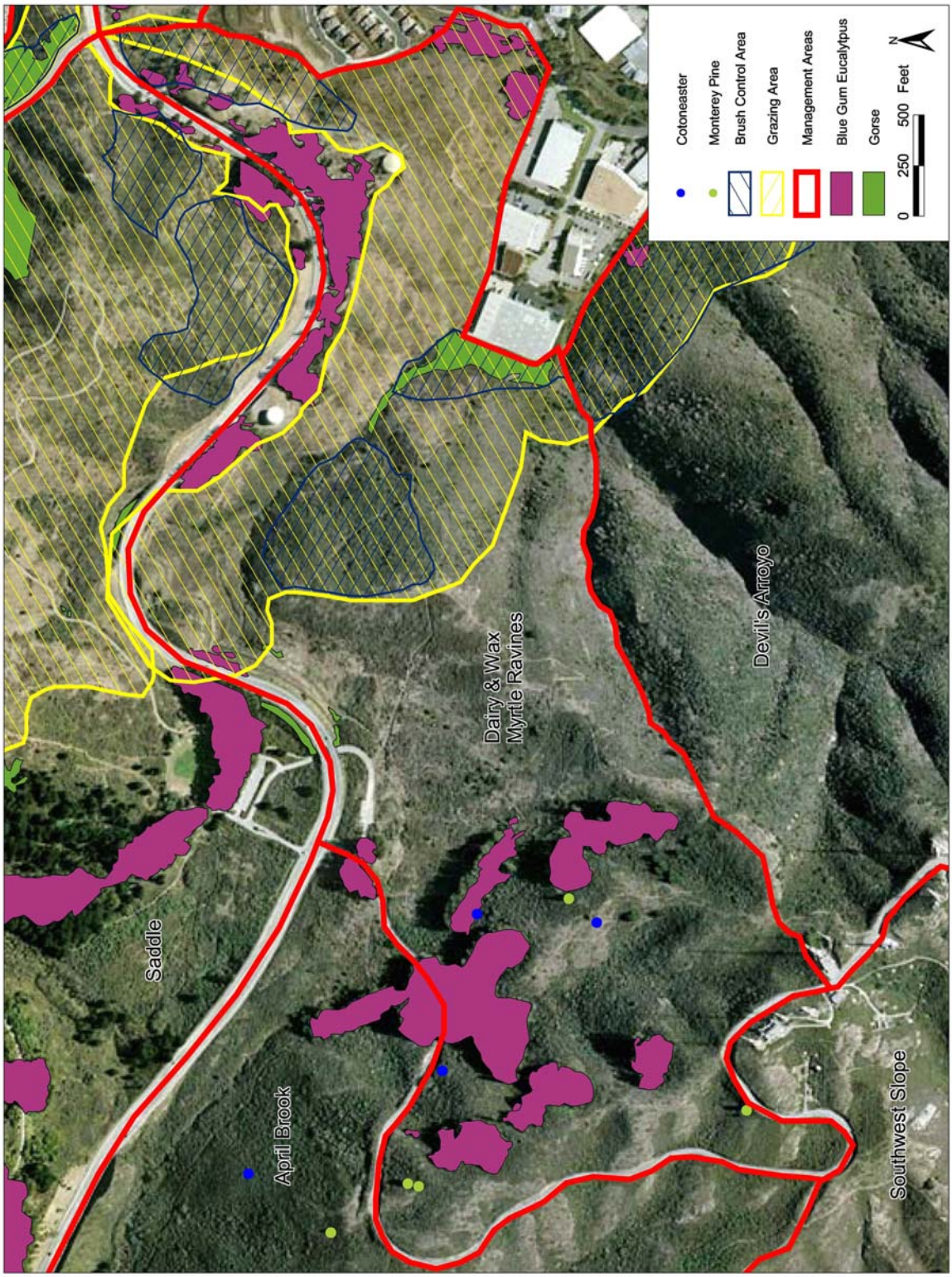
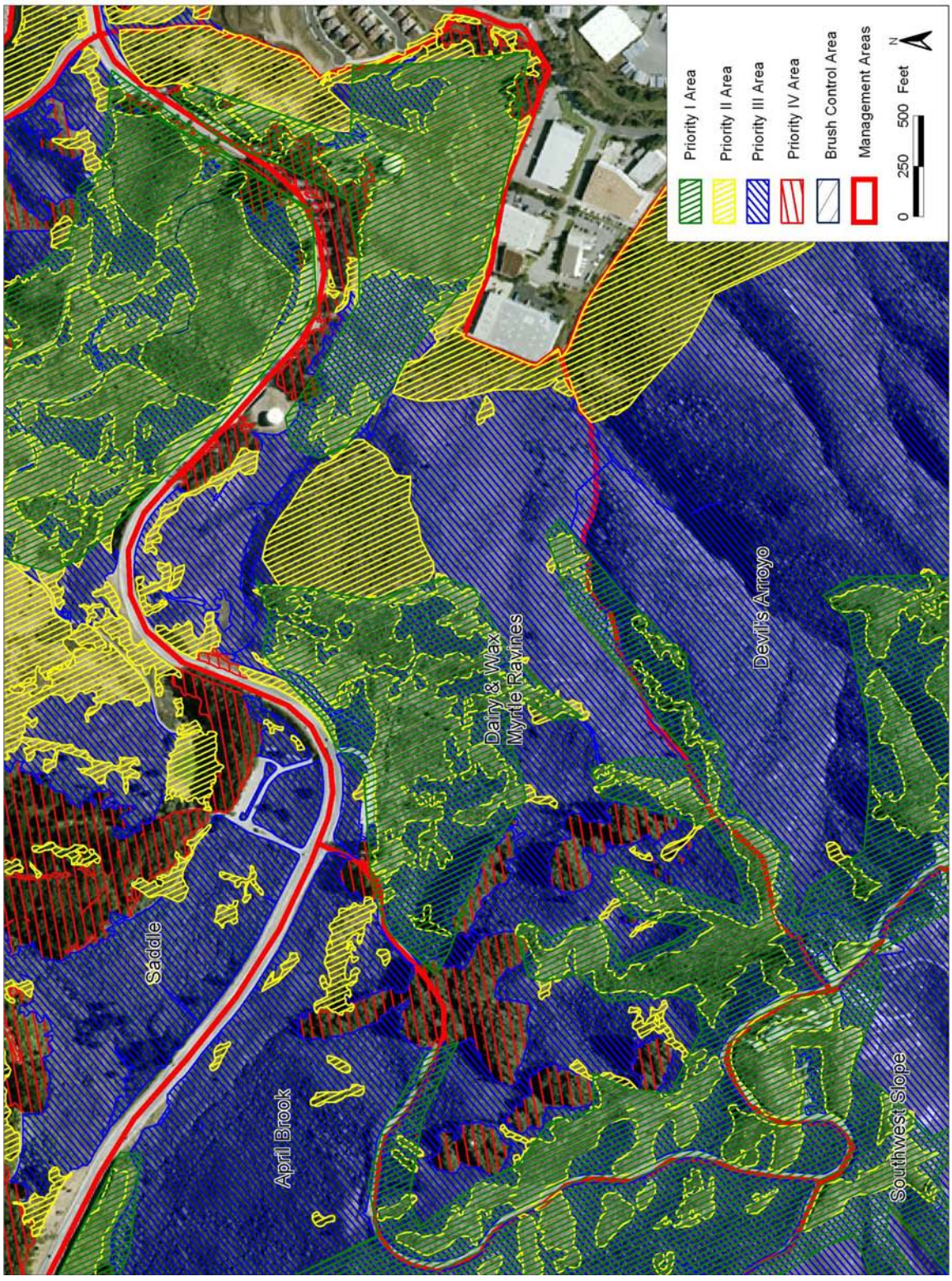


Figure 16. Dairy and Wax Myrtle Ravines, Priority Management Areas



10. Southwest Slope (436 acres)

Figures 17 and 18

Southwest Slope is composed of steep south facing slopes on the west side of San Bruno Mountain. Summertime coastal fog strongly influences the vegetation, which is dominated by coastal scrub with patches of native grassland along ridgelines and isolated side slopes. The management unit is bordered by the Cypress AMLOC landfill, the Cypress golf course and residential development within the City of Colma.

Resource	**Habitat Value**
Mission Blue	High
Callippe Silverspot	Low
San Bruno Elfin	Low
Bay Checkerspot	Low
Native Plant Community Diversity and Dominance	High

This management unit is composed of steep, rocky slopes and ravines dominated by coastal scrub vegetation (Figure 17). The unit was likely used for cattle grazing in years prior to the HCP. The Cypress AMLOC landfill is located at the base of the slopes and along the summit are a series of radio towers, dishes, transmission lines and buildings operated by American Tower Corporation and PG&E. The County Park ranger station is located on the west peak. The lower slopes have been disturbed from farming and horticultural practices on lands above Pacific Nursery.

Eucalyptus logging operations were conducted in 1995 on a 21-acre section of eucalyptus forest on slopes above Pacific Nursery that has since grown back. A 4-acre site was logged of eucalyptus in 1995 (above Hoffman Street) for restoration, and has converted to native and nonnative brush and weeds. The western low elevation grasslands are dominated by purple needlegrass and fescue bunchgrasses. The federally endangered San Francisco Campion (*Silene verecunda* ssp. *verecunda*) is located within this unit on the upper slopes near Radio Road. Approximately 20% of this unit is within the Priority 1 management area (Figure 18).

Coastal scrub requires infrequent burning to maintain healthy stands of grassland and brush. Mission blue habitat is scattered within patches of grassland and on fire roads along ridgelines. This unit has only very small patches of habitat for the San Bruno elfin and callippe silverspot butterflies.

Conservation Needs and Prescription

The unit needs infrequent controlled burns to protect and enhance the grassland patches within it, and reduce fuel loads within senescing coastal scrub habitat. Weed infestations within lower elevation ravines and disturbed areas need to be controlled. This management unit could benefit from creating a grazed buffer zone at the base of the slopes. The western low elevation grasslands dominated by purple needlegrass and

fescue bunchgrasses, need extensive invasives control work and would likely benefit from being grazed.

Figure 17. Southwest Slope, Invasive Species Map

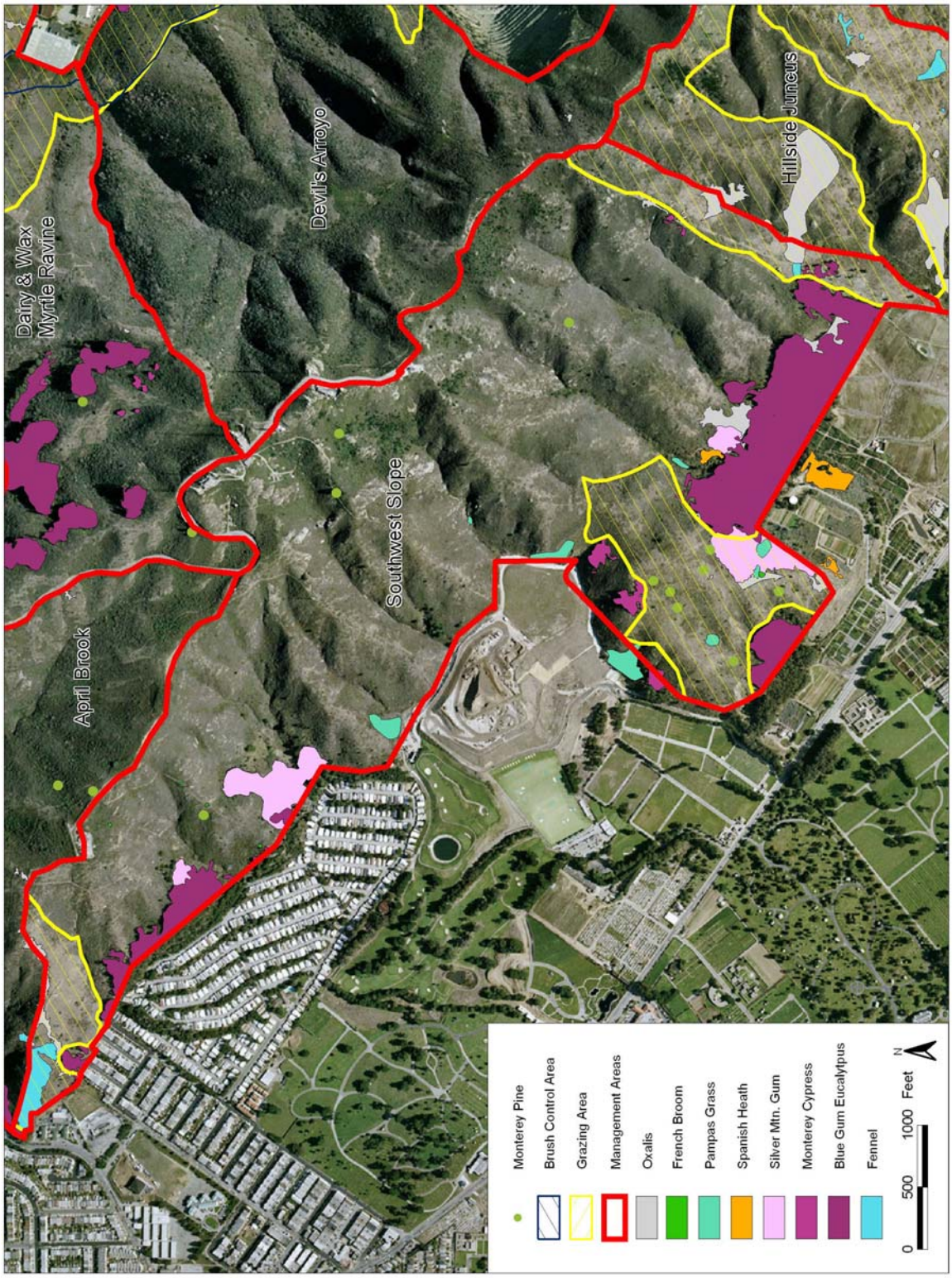
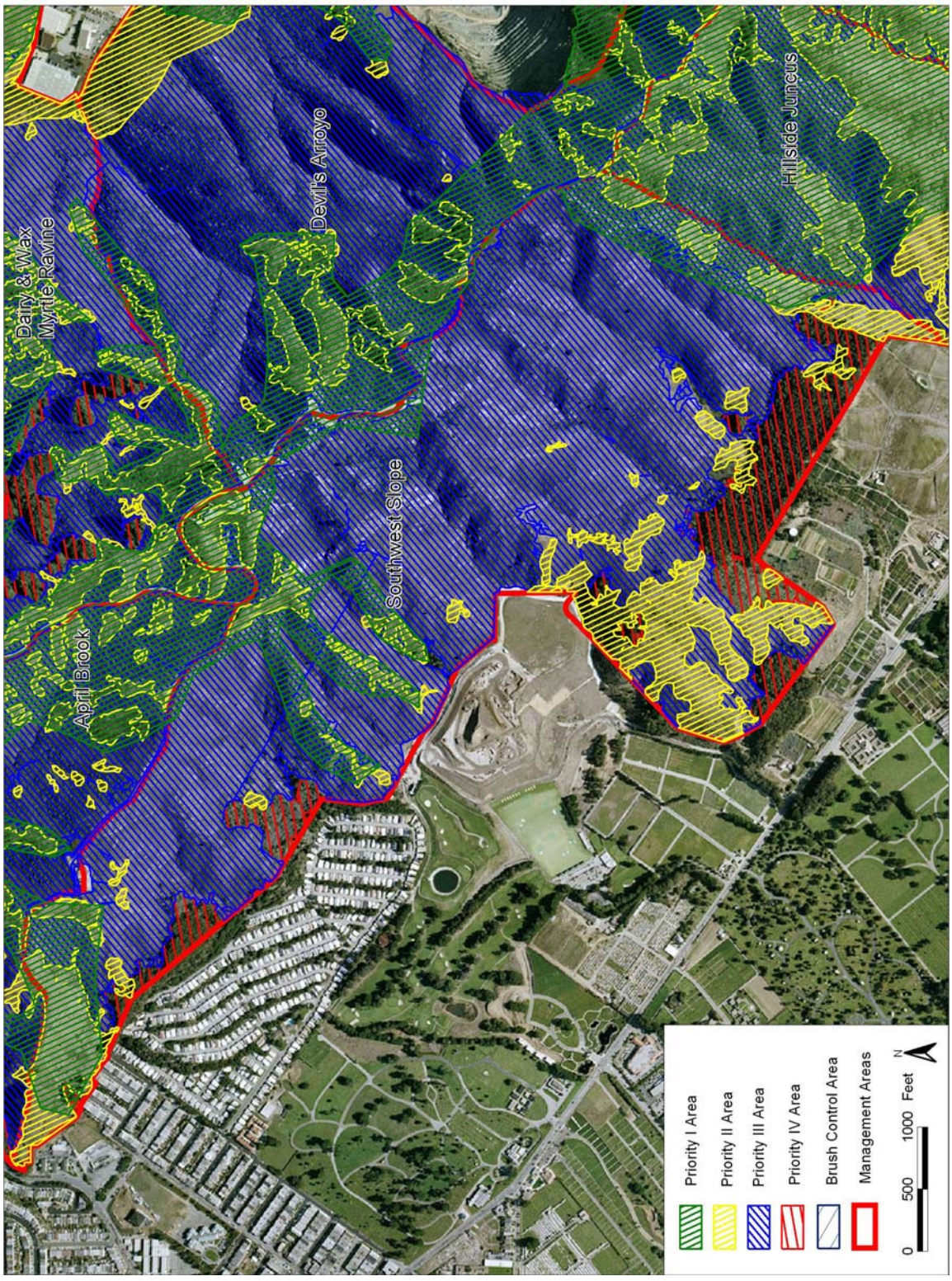


Figure 18. Southwest Slope, Priority Management Areas



11. April Brook (273 acres)

Figures 19 and 20

The April Brook management area is characterized by a mosaic of native grasslands, coastal scrub and rock outcrops occurring over a range of topography from rolling hills to relatively steep slopes and ravines. The Guadalupe Canyon Parkway forms the northern border of this unit. The April Brook area is a favorite for hikers on the Mountain due to its wide-open slopes covered by coastal prairie and moist scrublands. The Summit Trail loops through this management area and provides views of San Francisco, the ocean and the Farrallon Islands.

The lower slopes are typified by riparian forests and scrub along Colma Creek and associated drainages, while vegetation on the upper ridges are typified by fescue dominated prairies and rocky outcrops. Colma Creek flows westward and through the Colma Creek restoration site.

This management area has very limited mission blue and callippe silverspot habitat; however it provides moderate San Bruno elfin habitat, and contains large expanses of pristine grasslands and coastal scrub (Figure 19). A single dune tansy (*Tanacetum camphoratum*) plant is present within this unit. This area was likely grazed and burned in the past. In most areas native vegetation dominates this unit. A 4-acre eucalyptus removal and restoration project was conducted along Colma Creek. The Colma Creek restoration site has two mission blue habitat islands, and a mixture of grassland, coastal scrub, and arroyo willow riparian plant communities. Approximately 50% of this unit is within the Priority 1 management area (Figure 20).

Resource	**Habitat Value**
Mission Blue	Low
Callippe Silverspot	Low
San Bruno Elfin	Moderate
Bay Checkerspot	Low
Native Plant Community Diversity and Dominance	High

Conservation Needs and Prescription

Maintenance will likely require grazing and/or periodic prescribed burns in order to keep this area from converting to coastal scrub and to maintain a mosaic of open grasslands and scrub. The spread of non-native invasive species into this ecologically rich management area should be prevented. Conduct weed control work along roadsides and trailsides in this unit, to prevent the further expansion of herbaceous weeds and non-native grasses into the coastal prairies. Continue control on other weeds such as gorse, cotoneaster, acacia, and Monterey pines. Monitor and control for new invasive species problems such as Veldt grass (*Ehrharta ehrharta*) and Bermuda buttercup.

Figure 19. April Brook, Invasive Species Map

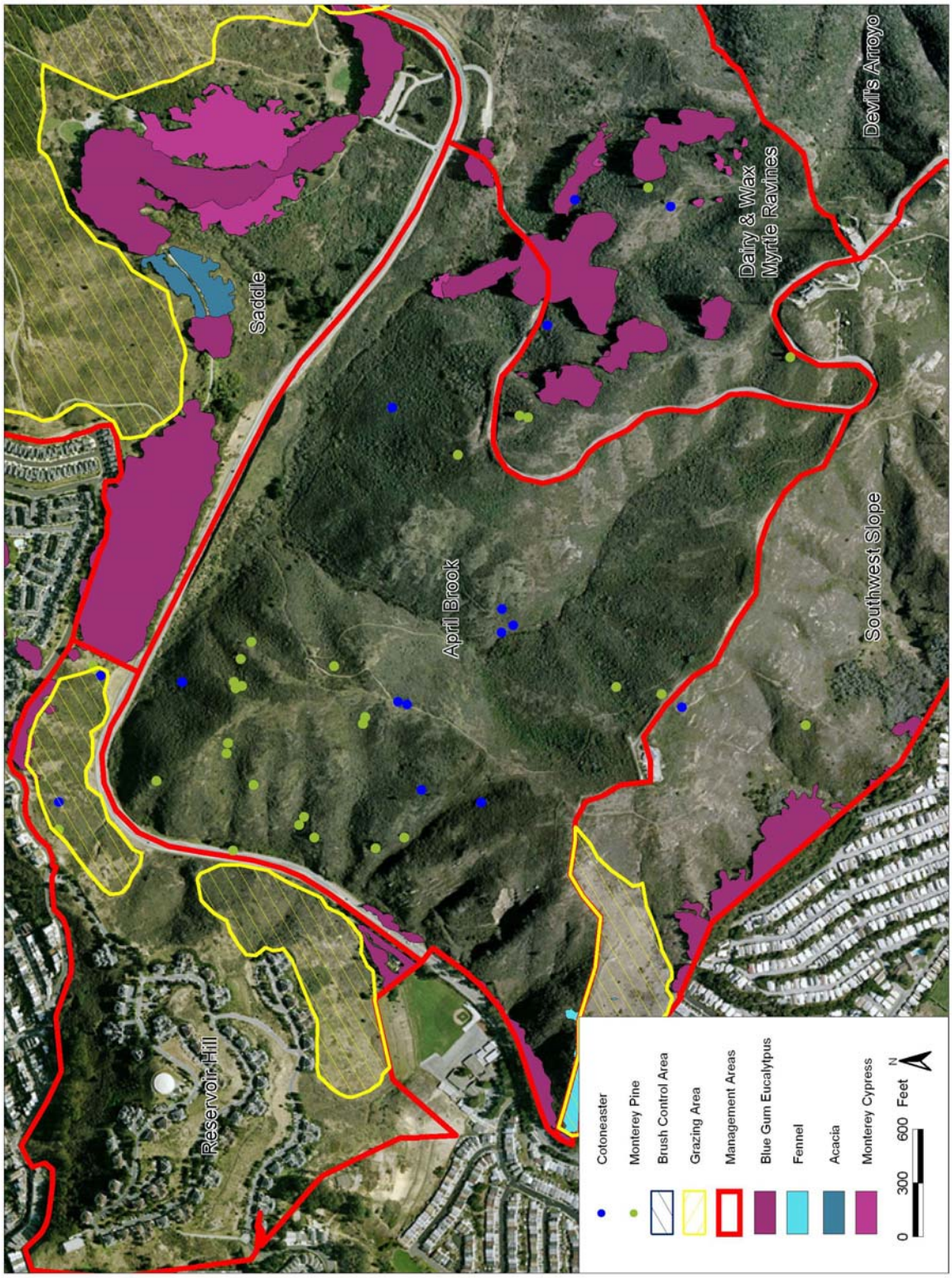
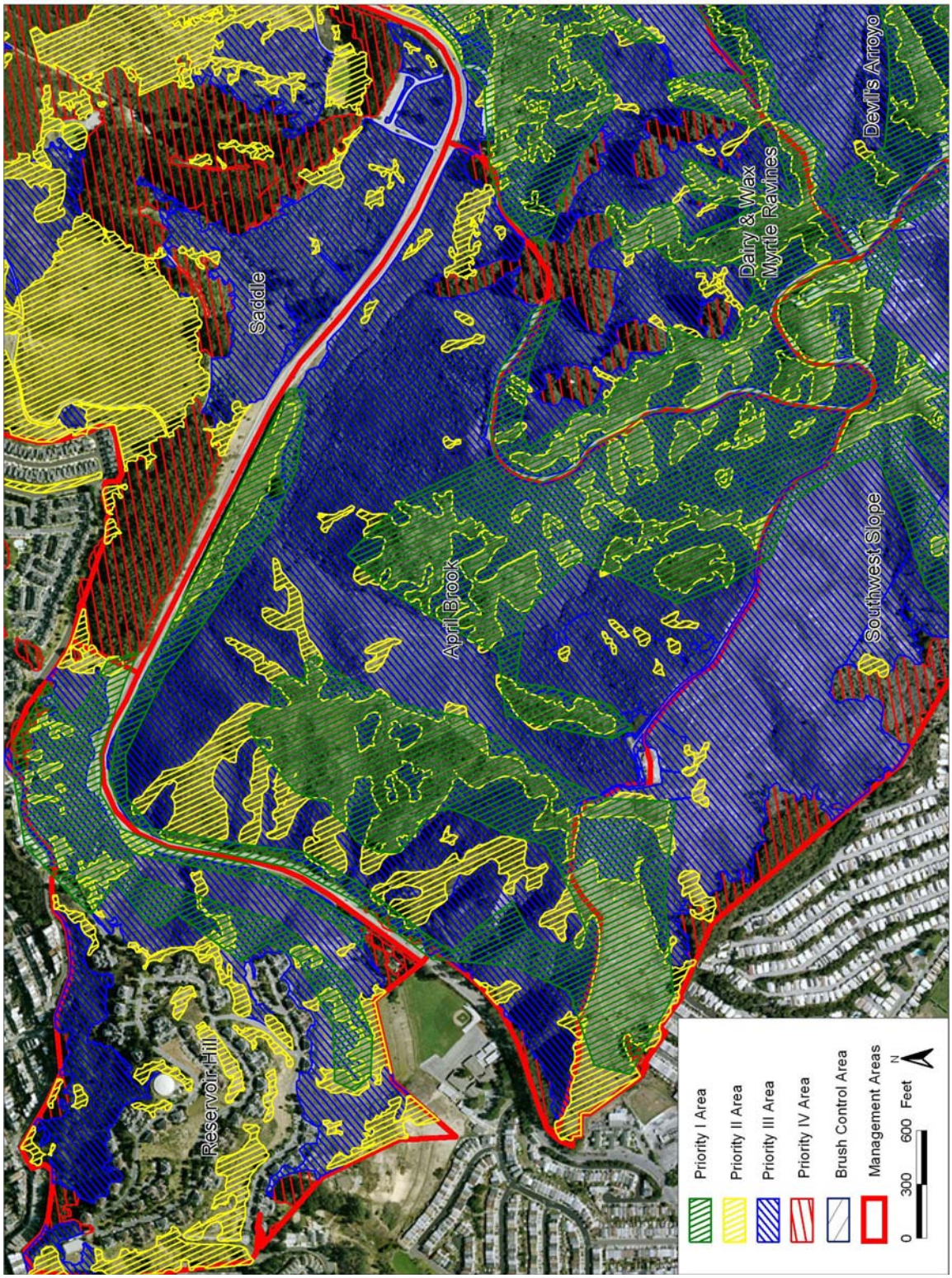


Figure 20. April Brook, Priority Management Areas



12. Saddle (320 acres)

Figures 21 and 22

The Saddle is bordered by Guadalupe Canyon Parkway on the south and east, and the City of Daly City on the north and west. Due to the large infestation of gorse once present in this unit, the unit has been the site for intensive gorse control treatments including herbicide, brushing, and burning since the inception of the HCP in 1982. The eastern slopes provide important grassland habitat for the callippe silverspot and mission blue butterflies. The north saddle is mostly made up of steep, inaccessible slopes primarily covered by gorse (Figure 21).

The headwaters of Colma Creek and the botanically-rich Saddle bog area are located on the western side of the unit bordering Guadalupe Canyon Parkway. Extensive freshwater marsh and riparian wetlands occur in the central portion of the bog. Colma Creek drains southward and under the Guadalupe Canyon Parkway. A headwaters restoration project to remove eucalyptus trees is being conducted through a California State Parks Grant, and managed by CNPS "Heart of the Mountain" and the San Mateo County Parks Division. Through a separate State Parks Grant, the Saddle has had approximately 50 acres of gorse controlled. The current estimate of gorse in the unit is 34 acres (2007). Approximately 30% of this unit is within the Priority 1 management area (Figure 22).

Resource	**Habitat Value**
Mission Blue	Moderate
Callippe Silverspot	Moderate
San Bruno Elfin	Not Present
Bay Checkerspot	Low
Native Plant Community Diversity and Dominance	Moderate

The central and western portions of the saddle consist of gradual slopes and were used for farming in the past. The eastern slopes are much steeper and were likely used for cattle grazing. A park visitor's area, parking lot, and picnic area are located in this unit just north of Guadalupe Canyon Parkway. HCP approved developments were built along Carter Street adjacent to Daly City housing. This unit receives most of the visitor usage in the Park, in the form of hiking, jogging, and picnicking. This site has patches of gorse on the north side of the Saddle that needs to be managed for fire hazard reduction.

Management under the HCP has focused on controlling gorse, Himalaya blackberry, iceplant, pampas grass, and cotoneaster. One mission blue habitat island has been created within a former gorse patch in the central saddle.

Conservation Needs and Prescription

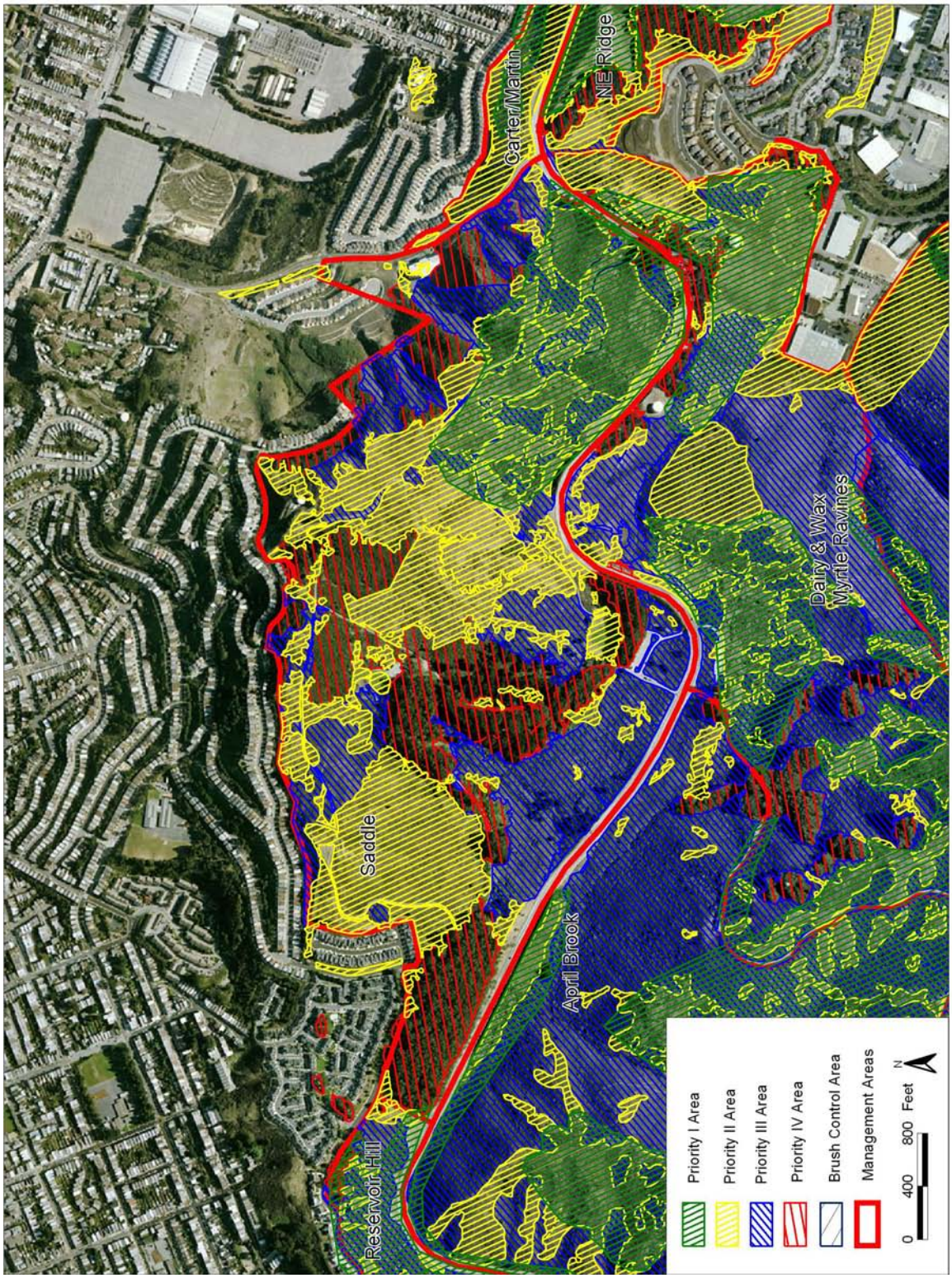
Managing the areas of gorse and coastal scrub in the eastern Saddle is a high priority and these areas need continued maintenance. In addition, habitat areas on the eastern

slopes for callippe silverspot and mission blue are threatened by coastal scrub expansion. Focus should be on maintaining habitat areas on the eastern slope through prescribed burning.

Burns and grazing may be important for managing brush and thatch within grasslands but significant follow-up efforts are necessary to control the high number of gorse seedlings that recruit immediately after disturbance. The Saddle needs to be managed to control species such as English ivy, Monterey cypress, Cape ivy, pampas grass, iceplant, velvet grass, Harding grass, orchard grass, cotoneaster, and Himalayan blackberry to restore native diversity and plant community structure. This work should be done in coordination with previous grant-funded projects in the central Saddle and Colma Creek.

Figure 21. Saddle, Invasive Species Map

Figure 22. Saddle, Priority Management Areas



13. Reservoir Hill (127 acres)

Figures 23 and 24

This management unit is bordered by Guadalupe Canyon Parkway on the east and the cities of Daly City and San Francisco on the west and north respectively. Plant communities include northern coastal scrub, coastal terrace prairie, Eucalyptus forest, central dune scrub, and non-native grassland (Figure 23). Special-status plants found on Reservoir Hill include San Francisco lessingia (*Lessingia germanorum*; FE, CE, CNPS 1B), and San Francisco spineflower (*Chorizanthe cuspidata* var. *cuspidata*; CNPS 1B). Reservoir Hill has a high habitat value for mission blue butterflies. The Pointe Pacific development, which was built in the early 1980's as part of the HCP occupies the central and western portions of the unit. On the western side the unit has large expanses of coastal scrub with patches of grassland that extend from Guadalupe Canyon Parkway to the Pointe Pacific Development and Crocker Avenue to the north. A 4-H Club is located at the base of the unit along Guadalupe Canyon Parkway. Approximately 30% of this unit is within the Priority 1 management area (Figure 24).

Resource	**Habitat Value**
Mission Blue	High
Callippe Silverspot	Low
San Bruno Elfin	Low
Bay Checkerspot	Low
Native Plant Community Diversity and Dominance	Moderate

The unit is composed of mostly steep slopes with the exception of the Pointe Pacific development, which is located on a plateau area. A large water tank is located on the highest peak within the development. The land was primarily used for cattle grazing and for water storage for the city of Daly City. Local residents and visitors use the area for hiking.

Large stands of coastal scrub exist down slope of the Pointe Pacific development and adequate fire buffers need to be maintained to protect the residential areas from wildfire. Eucalyptus groves occur within portions of this unit.

Conservation Needs and Prescription

Expansion of coastal scrub within this unit in the absence of burning and/or grazing has reduced the amount of grassland to small isolated patches. These grasslands should be opened up through manual removal of scrub or grazing, while existing butterfly habitat is maintained. Also important is the maintenance and restoration of existing portions of dune scrub and associated rare plant species. This rare community and its plant populations are threatened by iceplant (*Carpobrotus* sp.) and other non-natives. Management techniques such as herbicide application should be used to control non-natives. Logging and manual removal of eucalyptus is also recommended. This management unit could also be considered for the establishment of habitat islands.

Figure 23. Reservoir Hill, Invasive Species Map

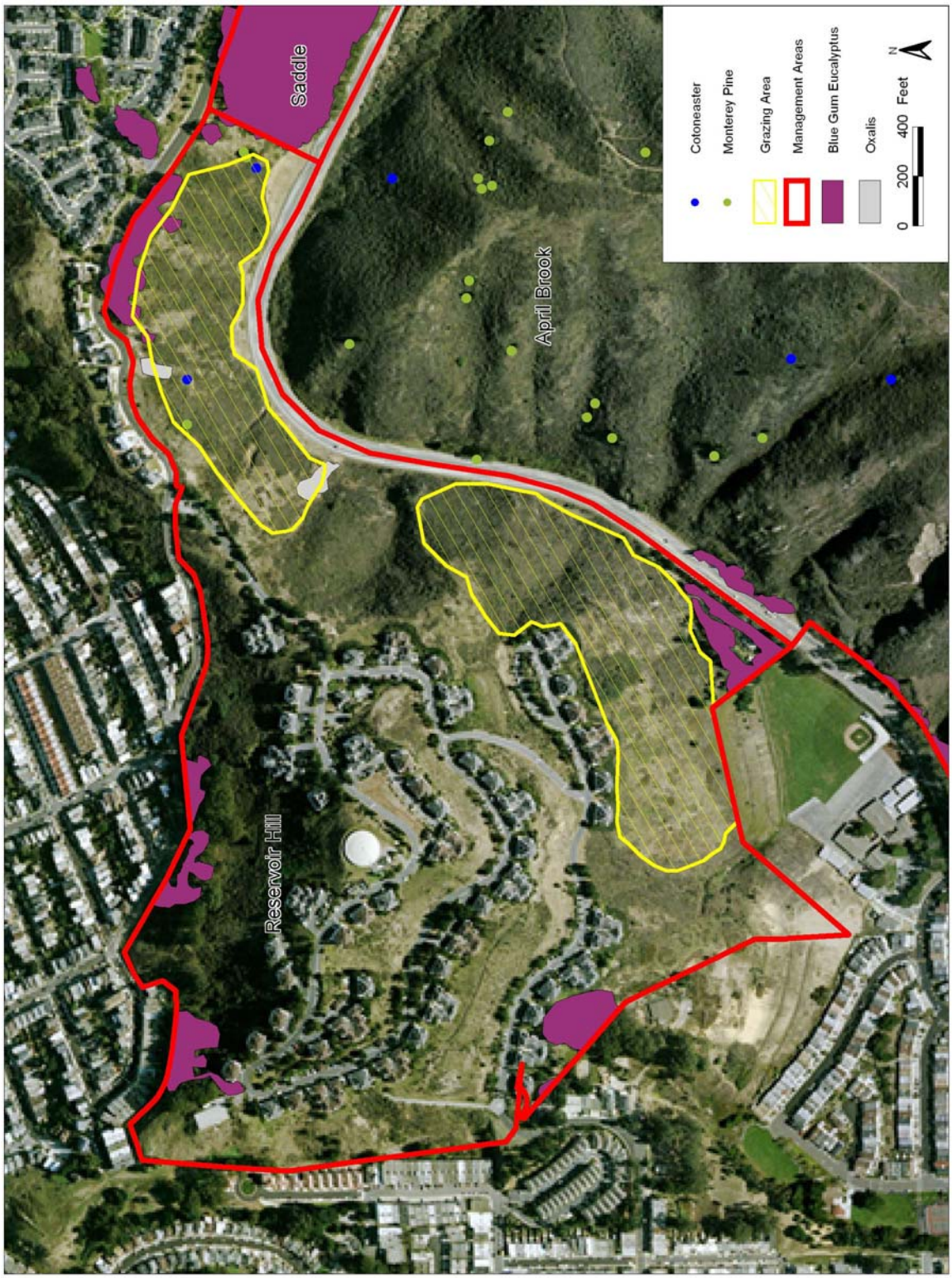
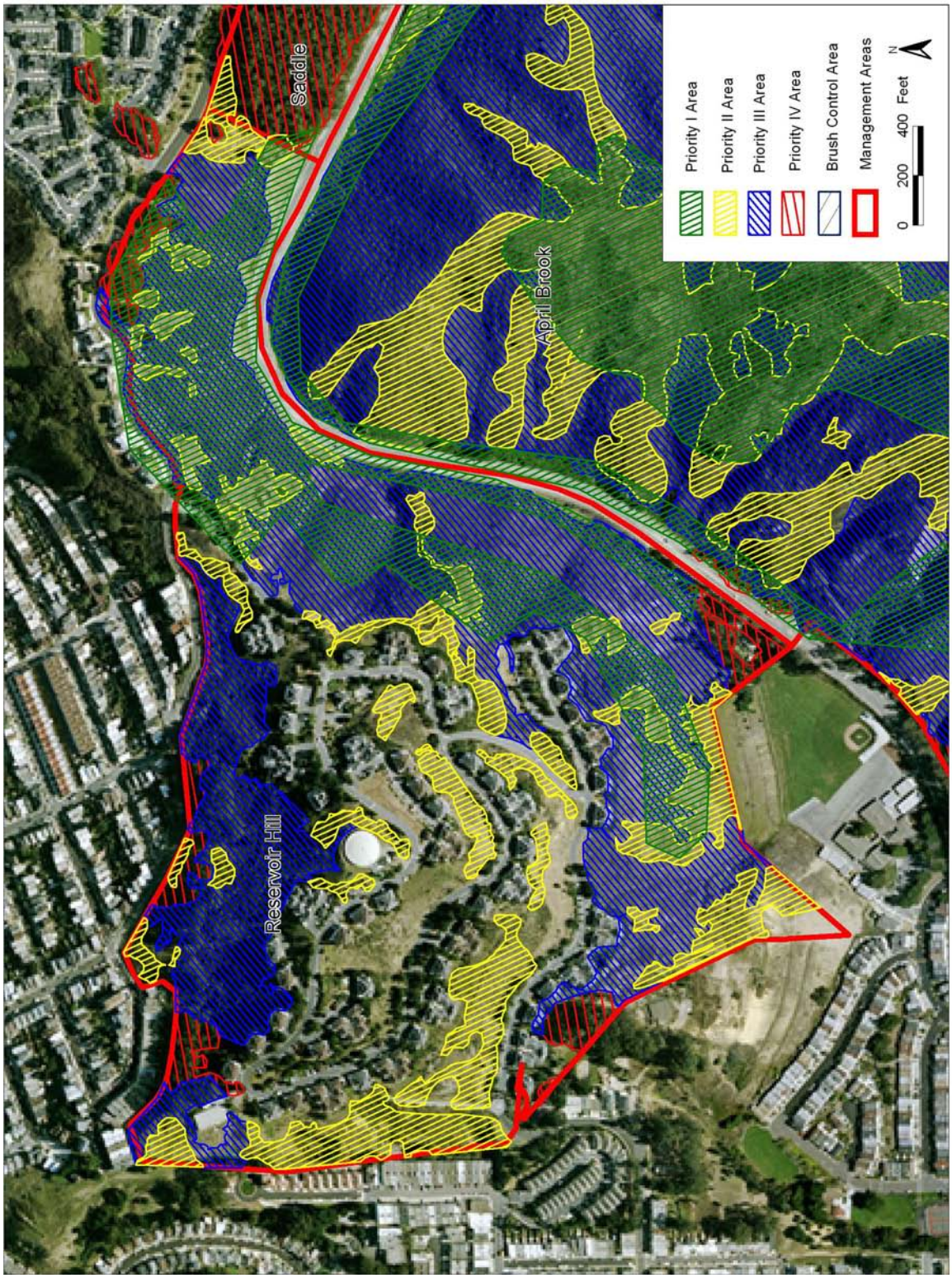


Figure 24. Reservoir Hill, Priority Management Areas



Guadalupe Quarry

The Guadalupe Quarry (96 acres) is operated by California Rock and Asphalt and is not a current participant to the San Bruno Mountain HCP. California Rock and Asphalt is responsible for vegetation management as part of their mining permit requirements under the jurisdiction of the County of San Mateo. Slopes on the upper benches and above the active mining area of the Quarry, have habitat for the mission blue, callippe silverspot, and San Bruno elfin. If these lands are dedicated to the HCP area in the future, then HCP habitat management would be expanded to include this area.

Resource	**Habitat Value**
Mission Blue	Moderate
Callippe Silverspot	High
San Bruno Elfin	High
Bay Checkerspot	Moderate
Native Plant Community Diversity and Dominance	Moderate

APPENDIX B

Butterfly Habitat Restoration Guidelines

SAN BRUNO MOUNTAIN HABITAT CONSERVATION PLAN
MISSION BLUE AND CALLIPPE SILVERSPOT
BUTTERFLY HABITAT RESTORATION GUIDELINES

Prepared by

Patrick Kobernus
Thomas Reid Associates

Updated: August 2003

Objectives

The purpose of this document is to provide information to professional and volunteer restorationists that are conducting work to restore endangered butterfly habitat on San Bruno Mountain. Restoration of graded or disturbed lands are a requirement of the San Bruno Mountain Habitat Conservation Plan (HCP). The primary goal of the restoration work is the establishment of high quality habitat for the Mission blue (*Icaricia icarioidies missionensis*) and Callippe silverspot (*Speyeria callippe callippe*) butterflies. Restoration work has been ongoing on the Mountain since the mid-1980's.

The following guidelines address some of the previous problems and will assist restoration professionals and volunteers with accomplishing the habitat restoration goals of the HCP. They should be used in conjunction with the *Standards for Acceptance of any Dedicated Lands by the County of San Mateo in Accordance with the San Bruno Mountain Area Habitat Conservation Plan*, prepared by Roman Gankin, San Mateo County.

Problems to Avoid

The following is a list of problems that have occurred in the past with restoring butterfly habitat on San Bruno Mountain:

1) Not enough seed is collected (i.e. the seed collection window is missed, or there is a lack of knowledge of where to collect).

2) Propagated plants are too small and root structure is not developed enough to survive the first few months after installation.

3) Plants are not planted in appropriate locations. (i.e. host plants are planted in areas that are too moist or too rocky).

4) Plants are not sufficiently protected from herbivore predation (e.g. snails, brush rabbits, mice).

5) Invasive species, coastal scrub, and/or weedy annual grasses and forbs are not controlled well enough around planting areas.

Measurement of Success

For successful establishment of butterfly habitat, four components are needed:

1) planting is done in appropriate **soils**
2) planting is done on appropriate **slope exposure** to provide wind shelter
3) planting is done with sufficient densities of **host and nectar plants**
4) planting sites are routinely **monitored and maintained** to insure plant survival

The best measure of success in establishment of endangered butterfly habitat is density of host plants. The following table shows the recommended densities of host plants that will provide high quality Mission blue (MB) and Callippe silverspot (CS) butterfly habitat. The figures in Table 1 should be used to determine how much seed to collect and how many plants should be propagated for restoration projects on San Bruno Mountain.

Table 1. Plant densities recommended to establish Mission blue and Callippe silverspot habitat. Based on natural habitat areas that support MB and CS colonies.

Requirement	**Mission Blue**	**Callippe Silverspot**[1]
Number of host plants (For planting, it is recommended that 2-4 times as many plants are planted per acre to account for 50-75% mortality).	A minimum of **100 *Lupinus albifrons* and/or *Lupinus formosus* plants** established per acre.	A minimum of **250 *Viola* pedunculata plants** established per acre.
Plant health	Plants should be well established, and have set seed for at least one growing season.	Plants should be well established, and have set seed for at least one growing season.
Planting design/ spacing	Established habitat should be concentrated in small habitat islands (0.1- 0.25 acres in size).	Established **habitat should have 500 - 1500 plants** within a large habitat island (0.1- 0.5).
Nectar plants	A minimum of **100 nectar plants** (combination of species) should be established per acre, concentrated within habitat patches.	A minimum of **100 nectar plants** (combination of species) should be established per acre concentrated within habitat patches.

1. For Callippe silverspot habitat, Viola patches tend to be more spread out. The smaller habitat island approach is still recommended due to the difficulty in controlling weeds within larger habitat patches.

The recommended plant densities were determined from biological data collected in 1999 in habitat areas that have supported consistent MB and CS colonies. The MB densities are based on data taken from fourteen 50 by 10 meter transects that have Mission blue utilization. The average number of lupines was found to be 67 medium-sized plants (2.5% cover) per 0.125 acre. Multiplying this number by 1.5 to account for lupines on the periphery of the transect that were likely contributing to the MB observations gives a total of 100 plants per 0.125 acres. Typically these high quality patches of roughly 100 plants occurs on the frequency of one patch per acre, or less.

The CS host plant densities are based upon *Viola* distribution data collected on the Northeast Ridge in 2000. The Northeast Ridge has had consistent observations of Callippe silverspots over the past 18 years of monitoring. The range of host plant densities estimated for Viola was approximately 500 - 1500 plants per acre on 25% of the lands of the Northeast Ridge. This corresponds to an average of 250 plants per

acre. ("plants"=clumps that appear to be individual units from above. Root structures were not investigated).

The Viola planting islands should be placed on appropriate soils, possibly higher up on the slopes to allow seed to spread downhill. Due to the difficulty in establishing grassland on steep graded slopes, the establishment of CS planting islands in the conserved habitat areas should be an option if it's determined that it's too difficult to establish Viola on the graded slopes. This is a satisfactory trade-off as long as the 250 plants per acre criteria is followed. (Establishing lupines on graded slopes has not been as difficult).

Habitat Islands

Planting should be done in relatively small islands where weeds can be controlled more easily. This approach cuts down on the area where maintenance is required. To determine appropriate planting areas with proper soil conditions and slope exposure, habitat island sites should be chosen with assistance from the Habitat Manager.

A recommended size for planting islands is from 0.1 - 0.25 acres. For monitoring purposes, these areas should be delineated in the field with stakes, and recorded on high resolution maps (preferably using GPS). The number of plants planted in each island area should be recorded and each plant or cluster of plants marked in the field with flagging or tags. Planted plants should be counted so they can be differentiated from plants that naturally colonize the site.

Seed Collection for Butterfly Host and Nectar Plants

For seed collection on San Bruno Mountain, two permits are required. First, a seed collection permit must be obtained from San Mateo County Department of Parks and Recreation. Also required is an HCP Site Activity Permit from the Habitat Manager. The Habitat Manager can suggest collection locations and provide information on the status of seed development for specific plant species.

Viola pedunculata seeds need to be collected in the spring (May) when the seed pods have ripened and have a black caste to them. The seed collection window is short, only a few weeks long. Several areas on the Mountain should be checked routinely in the spring to insure seed is collected.

L. albifrons and *L. variicolor* seeds need to be collected in May/June, *and L. formosus* in June/July. *L. albifrons* and *L. formosus* are the favored host plants for the mission blue butterfly, and these should be collected in much higher amounts than *L. variicolor*. When ripe, lupine seed pods become swollen and begin turning from green to brown.

Table 2 shows the butterfly plants and estimated time of year for seed collection. Plants should be inspected during the spring to assess plant stage because collection time can vary greatly from year to year.

Table 2. Host and nectar plants of the Mission blue and Callippe silverspot butterflies.

Butterfly	**Plants**	**Collection Time**
Host Plants		
Mission blue	*Lupinus albifrons*	May/June
Mission blue	*L. formosus*	June/July
Mission blue	*L. variicolor*	June
Callippe silverspot	*Viola pedunculata*	May
Nectar Plants		
MB & CS	*Eriogonum latifolium* (coast buckwheat)	Aug/Sept
MB & CS	*Monardella villosa* (coyote mint)	Aug
MB	*Phacelia californica*	July/Aug
MB & CS	*Cirsium quercetorum* (brownie thistle)	June/July
MB	*Heterotheca sessiliflora bolanderi* (A.K.A. *Chrysopsis villosa* (golden aster))	Aug/Sept
MB	*Achillea millefolium* (yarrow)	July/Aug
MB	*Sisyrinchium bellum* (blue-eyed grass)	June
MB & CS	*Horkelia californica*	July/Aug
MB	*Sidalcea malviflora* (checkerbloom)	May/June
MB & CS	*Dichelostemma capitatum* (blue dicks)	June

Seed Germination and Growing

Viola seeds should be put into a 3:1 (moistened peat/ seeds) mix that is then stratified in a refrigerator (40-45F) for 3 weeks to a month until they begin to germinate. Seedlings can then be taken out and sewn into stubbies (7 cubic inch cells). *Violas* need to be grown in the nursery for several months to over one year, and have a well developed root structure (25-75 % of cell is occupied by roots) before planting (personal communication Nicole Salgado, SLUG nursery).

Lupines require a pretreatment to break down the hard seed coat and accelerate germination. Seeds can be scarified by rolling seeds between sheets of sandpaper, then sewed into D-16 (16 cubic inch) cells. Lupines should be grown for approximately 6 months and have a well-developed root structure (25-75 % of cell occupied by roots) before planting.

Nectar plants should be sewn into flats and then moved into two inch square pots for growing. Plants should have a well developed root structure (25-75 % of cell occupied by roots) before planting.

Planting Strategies

Callippe Silverspot Habitat

1. Plant *Viola* in larger habitat islands on gradual to steep slopes where there is good soil development and grasses have already been well established. For rocky, graded slopes, consider using hydro-mulching and soil amendments (nutrients, mycorrhizae), to develop soil prior to any host plant planting.

2. Plant Viola as propagules in winter or as dormant root masses in fall*. Plant *Viola* in small clusters and mark them. Plants should be planted where soils are appropriate. Plant nectar plants in surrounding spaces between or on periphery of *Viola* clusters.

3. Routinely visit and maintain each planting island area by pulling large weeds, and mowing annual grasses around the host and nectar plants.

4. Consider using covering to protect the *Viola* from herbivorous animals (i.e. mice, rabbits).

5. Consider supplemental watering if necessary.

Mission Blue Habitat

1. Plant lupines in smaller habitat islands. Plants should be planted in disturbed soils in appropriate locations and not uniformly spaced apart. Plant *Lupinus albifrons* in rockier, thinner soiled locations and/or in deeper soil spots. Plant *Lupinus formosus* only in deeper soil or sandy soil spots.

2. Plant (or seed) *lupines* in small clusters and mark them. Plant nectar plants in surrounding spaces between or on periphery of lupine clusters.

3. Consider using snail bait if snail predation on lupine appears to be a problem.

4. Routinely visit and maintain each planting island area by pulling large weeds, and mowing annual grasses around the host and nectar plants.

5. Consider supplemental watering if necessary.

Vegetation Management

Restoration sites will probably require vegetation management to prepare and to keep slopes in a condition to support butterfly habitat. Techniques such as mowing, burning, herbicide treatment, or grazing should be incorporated into the long-term restoration plans. These techniques are needed to maintain the health and vigor of the native grassland habitat by reducing competition from weeds, coastal scrub, and annual

grasses, and removing thatch. Burning and grazing programs will require special permits/authorization from the County and/or other agencies before they can be implemented.

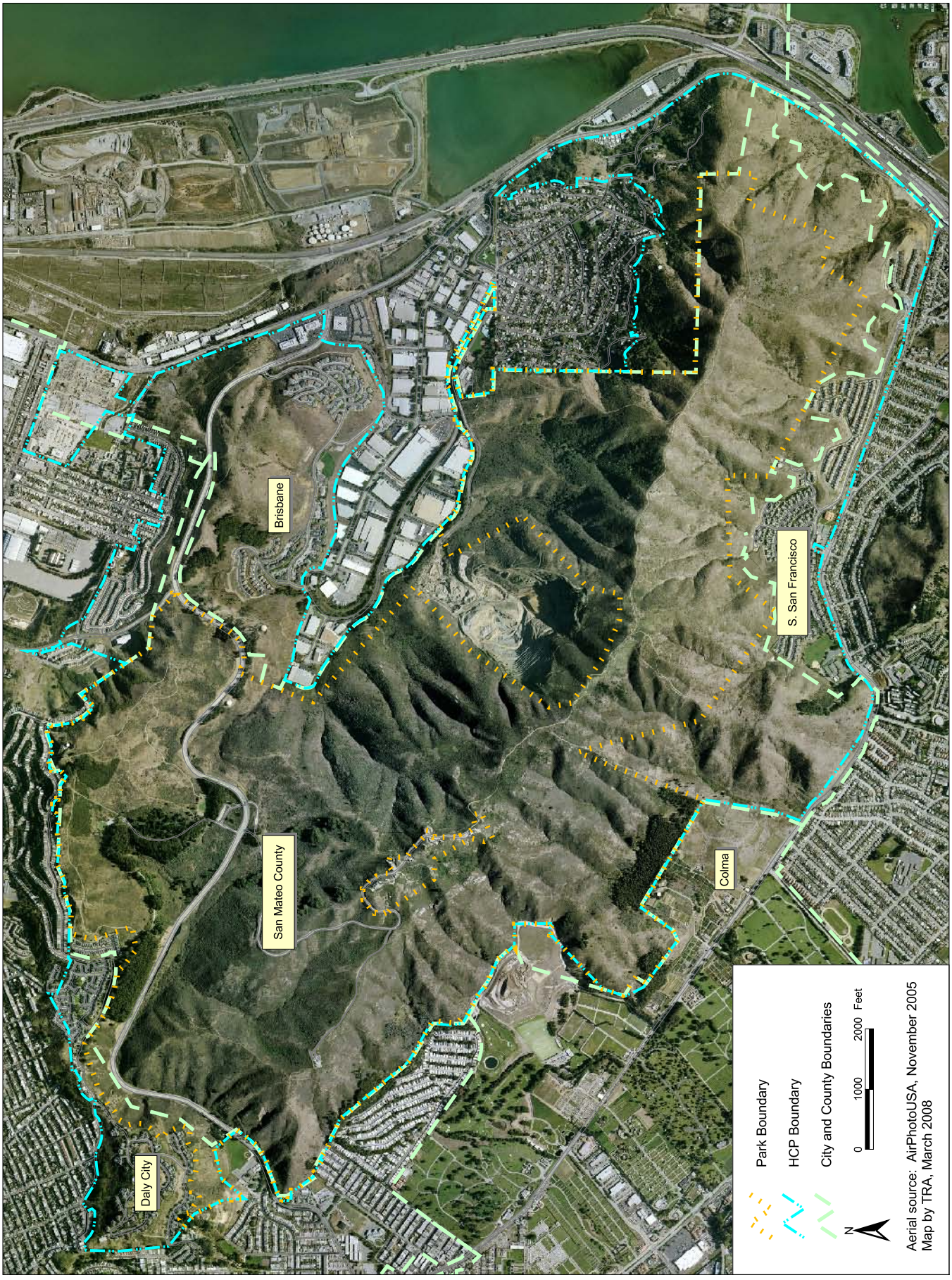
5-Year Maintenance Period

The HCP's mandatory 5-year maintenance period commences after all initial restoration work (erosion control, exotic plant control, and planting) has been completed. This period begins once the Plan Operator has determined that the property is stable from erosion, mostly free of exotic pest plants, and initial restoration seeding and/or planting has been successful.

If the Plan Operator has determined that butterfly habitat has been successfully established after the 5-year maintenance period has expired, dedication of the property can occur. If problems with exotic pest plants, erosion, poor survival of restoration planting, or habitat degradation from other factors is evident after 5 years has elapsed then the maintenance period would continue until the problems have been solved. Not until then would the Plan Operator determine that success is attained and accept the dedicated lands.

APPENDIX C

Additional Figures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San Mateo County
Daly City
S. San Francisco
Colma
Park Boundary
HCP Boundary
City and County Boundaries
0
1000
2000 Feet
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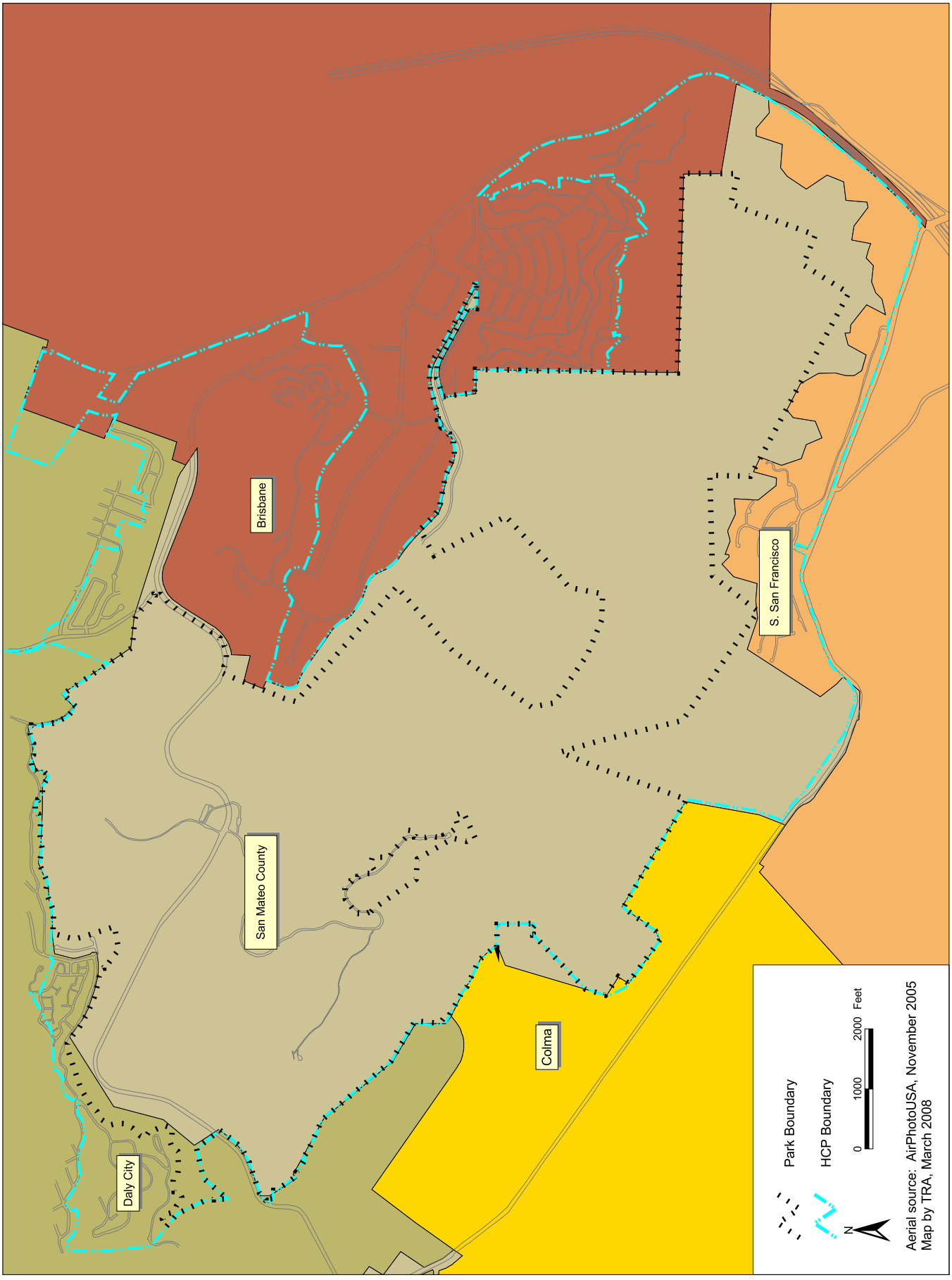
Aerial source: AirPhotoUSA, November 2005
Map by TRA, March 2008


Brisbane
S. San Francisco
San Mateo County
Colma
Daly City
Park Boundary
HCP Boundary
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2000 Feet
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Aerial source: AirPhotoUSA, November 2005
Map by TRA, March 2008

APPENDIX D

Special Status Species Lists for San Bruno Mountain

Appendix D. Special Status Species Lists for San Bruno Mountain

Table 1. Comprehensive list of Special Status Species on San Bruno Mountain

Name	Listing Status	Status on Mountain
Mission Blue butterfly (*Icaricia icarioides missionensis*)	Federal endangered	Present
San Bruno Elfin butterfly (*Callophrys mossii bayensis*)	Federal endangered	Present
San Francisco Garter snake (*Thamnophis sirtalis tetrataenia*)	Federal endangered	Not Present
Callippe Silverspot butterfly (*Speyeria callippe callippe*)	Federal endangered	Present
Bay Checkerspot butterfly (*Euphydryas editha bayensis*)	Federal threatened	No records since mid-1980's (Extirpated)
California Red-legged frog (*Rana aurora draytonii*)	Federal threatened	No records since 1970's (Extirpated)

Table 2. Host and Nectar Plant Species for Special Status Butterfly Species

Butterfly Larval Food* **and Adult Nectar Plants on SBM**	**Species**
**Sedum spathulifolium*	SBE
**Lupinus albifrons var. collinus*	MB
**Lupinus formosus var. formosus*	MB
**Lupinus variicolor*	MB
**Viola pedunculata*	CS
**Plantago erecta*	BC
**Castelleja densiflora*	BC
Lomatium utriculatum	SBE
Chrysopsis villosa	MB
Eriogonum latifolium	MB
Brodiaea pulchella	MB
Carduus pycnocephala (E)	CS, MB
Silybum marianum (E)	CS, MB
Monardella villosa	CS, MB
Horkelia californica	CS, MB
Cirsium quercetorum	CS, MB
Scabiosa atropurpurea (E)	CS

Table 3. Other Sensitive Animal Species on San Bruno Mountain

Animals	**Listing Status**	**Status on Mountain**
Solitary bee (*Dufourea stagei*)	Not proposed for listing	Unknown
San Francisco Tree Lupine moth (*Grapholita edwardsiana*)	Proposed Federal threatened, expired 1980	Unknown

Table 4. Rare Plant Species on San Bruno Mountain

Rare Plants	Listing Status	Status on Mountain
Arctostaphylos imbricata imbricata	FE, SE, CNPS 1B	Present, mapped in 2002
Arctostaphylos montaraensis	CNPS 1B	Present, mapped in 2002
Arctostaphylos pacifica (regarded as hybrid of A. uva-ursi & A. glandulosa)	Not listed.	Present, mapped in 2002
Arctostaphylos uva-ursi	No status	Present, mapped in 2002
Chorizanthe cuspidate cuspidata	CNPS 1B	Present, unmapped.
Grindelia hirsutula maritima	CNPS 1B	No records
Helianthella castanea	CNPS 1B	Present, mapped in 2001
Lessingia germanorum	FE, SE	Present, mapped in 2003.
Pentachaeta bellidiflora	FE, SE, CNPS 1B	No confirmed records
Plagiobothrys chorisianus	CNPS 1B	Unknown
Silene verecunda verecunda	FSC, CNPS 1B	Present, mapped in 2001
Tanacetum camphoratum	No status Not historically present.	Present, mapped in 2003 (only 2 plants, both transplanted).
Triphysaria floribunda	CNPS 1B	Not observed on SBM since 1960's.
Vaccinium caespitosum	No status	Present, rare, mapped in 2002

Table 5. Plant Species of Special Significance

Range Limit Plants	**Listing Status**	**Status on Mountain**
Arabis blepharophylla	CNPS 4	Present, common
Castilleja franciscana	No status	Present, common
Cirsium quercetorum	No status	Present, common
Clarkia rubicunda	No status	Present, common
Erysimum franciscanum var. *franciscanum*	CNPS 4	Present, common
Heterotheca villosa	No status	Present, common
Lathyrus vestitus	No status	Present, common
Layia hieracioides	No status	Unknown
Ligusticum apiifolium	No status	Present, common
Maianthemum kamtschaticum (dilatatum)	No status, range limit	Unknown
Ribes menziesii var. leptosmum	No status	Unknown
Sambucus callicarpa	No status	Present, common
Senecio aronicoides	No status	Present, common
Silene scouleri grandis	No status	Present, uncommon

APPENDIX E

Invasive Priority Plant List

Appendix E. Invasive Priority Plant List

2007/2008 San Bruno Mountain Exotics Priority Plants List (Draft: To be finalized by the TAC Committee & Members

Mike Forbert, West Coast Wildlands, January 2008

Scientific Name	Common name	*SBM Listed Noxious Weed* Priority Rating: A=Severe, B=Moderate, C=Limited, N/R=No Rating	*Cal-IPC Listed Noxious Weed* Priority Rating: A=Severe, B=Moderate, C=Limited, N/R=No Rating	*CA. State Listed* Priority Rating: A=Severe, B=Moderate, C=Limited, N/R=No Rating
Species	***Species***			
Grasses	**Common Name**	**Rating**	**Rating**	**Rating**
Avena (sp)	Wild Oat	B	B	N/R
Briza maxima	Rattlesnake grass	B	B	N/R
Bromus diandrus	Ripgut brome	B	B	N/R
Bromus hordaceus	Soft chess	C	B	N/R
Cortaderia jubata	Jubatagrass	A	A	N/R
Erharta erecta	Erharta	A	A	N/R
Holcus lanatus	Velvet grass	A	B	N/R
Lolium multiflorum	Annual ryegrass	B	B	N/R
Phalaris aquatica	Harding grass	B	B	B
Forbs/Herbs				
Carduus pycnocephalus	Italian thistle	A	B	C
Carpobrotus edulis	Iceplant	B	A	N/R
Centaurea calcitrapa	Purple star thistle	A	B	N/R
Centaurea melitensis	Napa thistle	A	B	N/R
Centaurea solstitialis	Yellow star thistle	A	A	C
Centranthus ruber	Red valerian	A	B	N/R
Chenopodium album	Lambsquarter	B	N/R	N/R
Cirsium vulgare	Bull thistle	B	B	N/R
Conium maculatum	Poison hemlock	B	B	N/R
Delairea odorata	Cape ivy	A	A	N/R
Digitalis sp.	Fox glove	C	C	N/R
Echium candicans	Pride of Madera	C	C	N/R
Erechtites arguta	New Zealand fireweed	C	C	N/R
Erodium cicutarium	Redstem filaree	C	C	N/R
Euphorbia lathyrus	Gopher Spurge	B	C	N/R
Foeniculum vulgare	Fennel	A	A	N/R
Hedera helix	English ivy	A	A	N/R
Hirschfeldia incana	Summer mustard	B	B	N/R
Hypochaeris radicata	Hairy dandelion	C	C	N/R
Lactuca serriola	Prickly lettuce	C	C	N/R
Lactuca virosa	Wild lettuce	C	C	N/R
Leucanthemum vulgare	Oxeye daisy	A	B	N/R
Lobularia maritima	Sweet alysum	B	C	N/R
Lythrum salicaria	Purple loosetrife	A	A	B
Oxalis pes caprae	Bermuda buttercup	A	B	N/R
Picris echioides	Bristly ox-tongue	A	B	N/R
Raphanus raphanistrum	Wild radish	A	B	N/R
Rumex acetosella	Sheep sorrel	C	C	N/R
Rumex crispus	Curly dock	C	C	N/R
Scabiosa atropurpurea	Pincusion plant	A	N/R	N/R
Silybum marianum	Milk thistle	C	C	N/R
Solanum sp.	Nightshade	C	N/R	B
Vinca major	Periwinkle	C	C	N/R
Zantesdeschia aethiopica	Calla lilly	C	C	N/R
Shrubs				
Cotoneaster sp.	Cotoneaster	B	B	N/R
Cytisus striatus	Portuguese broom	A	B	C
Genista monspessulana	French brom	A	A	C
Helichrysum petiole	Licoraceplant	C	C	N/R
Pyracantha crenato-serrata	Pyracantha	C	C	N/R
Rubus armeniacus	Himalaya blackberry	A	A	N/R
Ulex europaeus	Gorse	A	A	B
Trees				
Cupressus macrocarpa	Monterey cypress	B	B	N/R
Eucalyptus globulus	Tasmanian blue gum	A	B	N/R
Myoporum laetum	Myoporum tree	B	B	N/R
Pinus radiata	Monterey pine	B	B	N/R

APPENDIX F

Site Activity Permit Form

COUNTY OF SAN MATEO
Parks and Recreation Division
County Government Center
Redwood City, CA 94061

When completed FAX to:
Thomas Reid Associates (TRA) (650) 327-4024
Sam Herzberg, San Mateo County (650) 599-1721

SAN BRUNO MOUNTAIN
HABITAT CONSERVATION PLAN SITE ACTIVITY PERMIT

not a valid permit until approved below

PROJECT: _____ LEAD AGENCY: _____

PROPERTY OWNER: _____DATE:_____

APPLICANT:_____ CONTACT PERSON:_____

ADDRESS: _____

PHONE:_____ EMAIL:_____

HCP Administrative Parcel Number:_____

Project Description (include site maps - 1" = 200 ft. - discuss access, parking, equipment storage, spoils disposal, etc.): Attach maps, and a separate sheet or report if necessary.

Equipment required:_____

_____

_____

Personnel required:_____

_____

Onsite contact (name, telephone):_____

Job schedule (daily): _____

_____

_____

_____

_____

Scope of impact to habitat and proposed protective measures: _____

_____

_____

_____

If applicant and property owner are not the same, attach a copy of a document showing proof of the property owner's concurrence with or permission for the project, or initiation of the project, including a contract or other signed statement.

Applicant's Signature/Title: _____

****

FOR STAFF USE ONLY **PERMIT VALID UPON APPROVAL BELOW**

County Contact:_____ Phone:_____

Conditions of Approval: ☐ Inform TRA and San Mateo County when work is completed or stopped

_____

_____

Signature/Title:_____ Date:_____

NOTE: Use Additional Pages for Further Description TRA: (01/06/2002)

This permit does not absolve applicant of responsibility to obtain all other applicable permits; this permit grants HCP Habitat Manager approval to projects within the San Bruno Mountain HCP. Other permits may be required.