

6.9 BILLY GOAT HILL

GENERAL DESCRIPTION AND LOCATION

Billy Goat Hill is a 3.5-acre Natural Area located in the Diamond Heights area of San Francisco, east of Glen Canyon Park (Figure 1-1). The top of the ridge within Billy Goat Hill reaches approximately 550 feet above sea level. The Natural Area at Billy Goat Hill is composed mainly of grasslands (Figure 6.9-1). Primary public access is provided by trails leading off of Beacon Street (the southern edge) and off of 30th and Castro Streets. Billy Goat Hill provides important habitat for native plants and populations of sensitive plant species; grassland habitat; regionally significant City views; and suitable habitat for a variety of bird species and special-status species of butterflies.

GEOLOGY, HYDROLOGY, AND TRAILS

This Natural Area is underlain by Franciscan bedrock including chert, sandstone, and an altered volcanic rock (lava) called “greenstone.” Most of the greenstone is buried under slope debris and is mapped as “thin rocky soil over bedrock” (Figure 6.9-2). The greenstone is exposed in a scarp along 30th Street on the north edge of the park (mapped as “slope”). The lava from which the greenstone was derived is referred to as “pillow lava” because of the rounded shapes formed by this volcanic flow rock being deposited in water. At the time active volcanoes were depositing the lava that would become this part of the Franciscan assemblage, what is now the San Francisco Peninsula was covered with seawater. The top of the hill is an exposure of chert with a very thin debris cover. Chert knobs also crop out above Beacon Street. The ancient terraces facing Beacon Street are underlain by sandstone. Shallow soil slips are common, as can be seen from the debris deposits on the terraces.

There is no surface water at the site. Drainage of the area is by overland flow. Some rainfall percolates into fissures in the rock, but runoff generally is rapid. Natural runoff-formed furrows on the slopes are not eroded extensively where there is ground cover, but gullies have developed on the slopes denuded of vegetation where numerous informal trails have been made.

A well-defined network (2600 feet) of earth trails occur in the park. Extensive foot traffic has worn most of the trails through the thin soil to the underlying bedrock. Runoff channeled along some of these trails increases erosion.

VEGETATION

The vegetation of Billy Goat Hill is classified into eight series (Table 6.9-1; Figure 6.9-3). These series are within four sub-formations: approximately 72 percent of the area is grassland; 15 percent is forest; 8 percent is scrub; and 5 percent is classified as “other” (developed areas,

ornamental vegetation, and rock outcroppings). Only one of these series, coyote brush scrub, is dominated by native species.

Forest

Three forest series were mapped at Billy Goat Hill: mixed exotic, blue gum, and pine forest. Within the Natural Area, only a small amount of land is covered by these species (0.53 acres). The mixed exotic series is the most abundant of these, accounting for approximately 0.38 acres. Small areas of blue gum forests (0.11 acres) and pine forest (0.04 acres) comprise the remaining forest series. A relatively large area of mixed exotic forest is found across Beacon Street from the Natural Area.

Grassland and Scrub

Two scrub series were mapped at Billy Goat Hill: native coyote brush scrub (0.18 acres) and invasive Himalayan blackberry (0.10 acres). Wild oat grassland is the only grassland series mapped at Billy Goat Hill, and at approximately 2.46 acres in size, it dominates the Natural Area. Native grassland species accounted for 27 of the 58 plant species observed during point sampling, but accounted for 51 percent of the cover.

Other

Two series were mapped as “other” habitats at Billy Goat Hill: ornamental and rock outcrops. Ornamental vegetation (0.05 acres) is a series consisting of landscape plantings found on the northern side of the Natural Area. The rock outcrops (0.11 acres) are mostly the result of road cuts that exposed the underlying bedrock.

Sensitive Plant Species

The only species considered sensitive for the purposes of this plan is the California saxifrage (*Saxifraga californica*). This species is considered locally sensitive by the local chapter of the California Native Plant Society (CNPS). The species was observed at Billy Goat Hill in 2001, but has not been seen since. None of the other species designated as sensitive for this management plan have been observed in the area. The California Natural Diversity Data Base (CNDDDB) does not report the occurrence of any sensitive plant species at Billy Goat Hill (CNDDDB 2005).

Invasive Plant Species

Six vegetation series dominated by invasive species account for over 3.14 acres of land at Billy Goat Hill. Most of this is wild oat grassland (2.46 acres). Areas of mixed invasive forest are encroaching into the Natural Area. Within the grassland, scattered pine and blue gum trees can be found.

WILDLIFE

Birds

The multi-storied complex habitat found within Billy Goat Hill and across the street from the Natural Area may provide some nesting and roosting habitat for a wide variety of species. The grassland and scrub habitats of Billy Goat Hill provide foraging habitat for raptors while the forests provide potential nesting habitat for these species. Habitat for smaller birds (songbirds) is available in the scrub habitats throughout the park. There are five species of birds considered locally sensitive that have been reported from Billy Goat Hill (Table 6.9-2) Of these six, barn swallow (*Hirundo rustica*) and lesser goldfinch (*Carduelis psaltria*) are know to nest within the Natural Area. No areas of important bird habitat were delineated for this Natural Area.

Mammals, Reptiles, and Amphibians

No animal surveys were conducted at Billy Goat Hill; however, common animals are likely to occur here. Small mammals such as the California meadow vole (*Microtus californicus*), house mouse (*Mus musculus*), and pocket gopher (*Thomomys bottae*) are likely to be found in this habitat. Large mammals such as raccoons (*Procyon lotor*), striped skunks (*Mephitis mephitis*) and Virginia opossum (*Didelphis virginiana*) are typical of urbanized parks in general and are expected to occur within Billy Goat Hill. Reptiles typical of grassland habitats, such as garter snakes, are suspected to occur here, but have not been reported. The CNDDDB does not report any sensitive species as occurring within the area (CNDDDB 2005).

Invertebrates

Sensitive Invertebrate Species

At least three special-status species of butterflies potentially occur within the City of San Francisco: mission blue butterfly (*Icaricia icarioides missionensis*), San Bruno elfin butterfly (*Incisalia mossii bayensis*), and bay checkerspot butterfly (*Euphydryas editha bayensis*). The CNDDDB does not report the occurrence of any special-status species of invertebrates at Billy Goat Hill (CNDDDB 2005).

MANAGEMENT AREAS

The Management Areas (MAs) at Billy Goat Hill have been delineated based on the presence of rich native grasslands. The MA-1 area supports the richest array of species, as well as more intact habitat than the MA-2 area which surrounds the MA-1 and buffers it. The MA-2 is itself surrounded on three sides by the MA-3 area which includes tree and grassland communities (Figure 6.9-4).

ISSUES AND RECOMMENDATIONS

Several conservation and recreation-related issues have been identified for Billy Goat Hill. Recommendations developed for each of these issues will guide restoration, enhancement, and maintenance work. In the following discussion, system-wide issues and recommendations (GR-1 for example; see Chapter 5) that apply to the entire Natural Area at Billy Goat Hill are presented first within each topical area, followed by site-specific issues and recommendations. Site-specific recommendations are keyed to the Management Area in which they should occur.

Site Improvements – Implementation of management recommendations at Billy Goat Hill would not change significantly the overall look of the park and would result in:

- an increase in habitat suitable for use by resident or migratory birds and other wildlife;
- increased and more sustainable populations of sensitive plants;
- increased educational opportunities from native plant demonstration gardens;
- enhancement of native grasslands; and
- improved access on designated trails to provide erosion control.

Billy Goat Hill has the potential to support a diverse array of plants and animals. Restoration and improvement of the existing grassland-scrub mosaic with native scrub species that provide food and shelter when combined with better grassland foraging habitat will improve habitat for resident and migratory birds. Eventually, the Natural Area will support more sustainable populations of sensitive plants. Recreational trail opportunities will be improved. This small hill could someday resemble the coastal scrub-grassland mosaic of San Bruno Mountain.

Vegetation

Issues relating to vegetation management at Billy Goat Hill involve the protection of sensitive species and habitats, typically through the control of invasive plants (GR-1) and management of sensitive species and vegetation series of limited distribution (GR-2). Specific actions to take in managing grasslands such as those present at Billy Goat Hill should be implemented (GR-3). No trees will be removed at Billy Goat Hill. Issues relating to the general safety of visitors and surrounding homes, fire hazards posed by vegetation and trees, and illicit activities must be considered during management of the Natural Areas (GR-13). In addition to these general recommendations, the following site-specific issues should be addressed.

Issue BG-1: Invasive species occur throughout Billy Goat Hill and pose a threat to the grasslands.

Recommendation BG-1a: Reduce and contain herbaceous and woody invasive species including radish, fennel, invasive pea, and annual grasses in all Management Areas. Within the MA-3 areas allow some fennel and other nectar seed and larval habitat plants to persist. Prevent the establishment of invasive trees into grasslands.

Recommendation BG-1b: Areas where invasive species have been removed shall be revegetated using appropriate native plants. Existing grasslands will be enhanced and diversified as appropriate (MA-1 and MA-2 areas). Specifically, within MA-1b existing sensitive plants such as California saxifrage and mosquito bills (*Dodecatheon hendersonii*) should be augmented to improve current populations. In addition, within MA-1b and MA-2a, efforts shall be taken to augment the existing rare or uncommon grassland plant species such as silver bush lupine (*Lupinus albifrons* var. *collinus*). Within MA-2a the existing non-native grassland should be slowly replaced with a grassland dominated by native species. The native scrub community within MA-2b shall be maintained and enhanced. Using diversity, cover, and density targets generated from reference sites within and around San Francisco, plant native grassland and scrub species into the appropriate areas (see Appendix B). Modify the scrub landscaping at road frontages and entryways (MA-2b) to favor showy perennial species.

Recommendation BG-1c: Maintain a periphery of tall trees in MA-3a and diversify areas at grassland interface with wildlife enhancing species and design. Maintain and enhance a grassland-scrub-tree mosaic in MA-3a in such a fashion that habitat complexity is increased along with cover and sources of food.

Wildlife

Implementation of system-wide recommendations that relate to vegetation management and nesting birds (GR-4), predation (GR-7), increasing cover for small mammals and birds (GR-9) and installation of host plants for native insects (GR-10) would all serve to enhance the wildlife habitat at Billy Goat Hill.

Birds

Issue BG-2: While the grassland habitat at Billy Goat Hill may be suitable foraging habitat for native birds, the scrub habitat they depend on for cover and nesting is limited at Billy Goat Hill. In a small park such as this one, nearby cover is an important part of the habitat structure that is required to allow birds to successfully sustain local populations.

Recommendation BG-2a: Implementation of BG-1b and BG-1c would result in increased native scrub community within MA-2b and MA-3a. Efforts should focus on creation and protection of a complex mosaic of grassland and scrub with a variety of species that will provide shelter, food, and nesting areas for local wildlife.

Soils, Erosion, and Public Use

The erosion and public use issues at Billy Goat Hill all relate to the trail system and public use. A network of roads and designated and social trails winds through all Management Areas (Figure 6.9-2). This plan proposes to improve and maintain 987 feet of trail, retain an additional 1,868

feet of unimproved trail, and close 745 feet of social trails. The issue of erosion and habitat impacts related to social trails is addressed through implementation of GR-11 and GR-12. Information relating to the ecosystem of Billy Goat Hill and its importance will be posted and maintained (GR-14).

Table 6.9-1. Vegetation series mapped at Billy Goat Hill.

	Vegetation Series	Total Acreage
Forest	blue gum forest	0.11
	mixed exotic forest	0.38
	pine forest	0.04
	Subtotal	0.53
Scrub	coyote brush scrub*	0.18
	Himalayan blackberry scrub	0.10
	Subtotal	0.28
Grassland	wild oat grassland	2.46
Other	ornamental	0.05
	rock outcrop	0.11
	Subtotal	0.16
Grand Total		3.43

* Indicates vegetation type is dominated by native species.

Table 6.9-2. Sensitive species presently and historically known to occur at Billy Goat Hill.

Species	Common Name	Status Federal, State, CNPS	Occurrence Status
ANIMALS			
<i>Hirundo rustica</i>	Barn Swallow	LS	Presently breeds
<i>Carduelis psaltria</i>	Lesser Goldfinch	LS	Presently breeds
<i>Buteo lineatus</i>	Red-shouldered Hawk	LS	Presently occurs
<i>Vermivora celata</i>	Orange-crowned Warbler	LS	Presently occurs
<i>Empidonax difficilis</i>	Pacific-slope Flycatcher	LS	Presently occurs
PLANTS			
<i>Saxifraga californica</i>	California saxifrage	LS	Observed in 2001

Status Key:

Federal Status

- FE* Endangered. Species in danger of extinction throughout all or significant portion of its range.
- FT* Threatened. Species likely to become endangered within foreseeable future throughout all or a significant portion of its range.
- FPE* Proposed for listing as endangered.
- FC* Candidate for listing as endangered. Candidate information now available indicates that listing may be appropriate with supporting data currently on file.
- FSC* Species of Concern. Former Category 2 Candidate for listing as endangered.
- FPD* Proposed de-listing.

California State Status

- SE* Endangered. Species whose continued existence in California is jeopardized.
- ST* Threatened. Species, although not presently threatened with extinction, that is likely to become endangered in the foreseeable future.
- SSC* Species of Concern.
- SFP* State Fully Protected under Sections 3511 and 4700 of the Fish and Game Code.
- Sens* Considered a sensitive species by the California Department of Forestry.

California Native Plant Society

- 1A Plants presumed extinct in California
- 1B Plants that are rare or endangered in California and elsewhere.
- 2 Plants that are endangered in California, but more common elsewhere.
- 3 Plants about which more information is needed.
- 4 Plants of limited distribution (a watch list).
- LS Locally Significant.

Golden Gate Audubon Society

- LS Locally Significant.



Source: Aerial photography San Francisco Department of Public Works, 2002, Orthophoto - San Francisco - 1-foot resolution, 2001; property boundary data derived by San Francisco Recreation and Park Department (RPD) 2005 from data provided by San Francisco Department of Telecommunications and Information Services, 2002; natural area boundary data created by San Francisco State University Institute for GISc from information provided by RPD's Natural Areas Program (NAP), 2005; contour lines provided by San Francisco Department of Conservation; all data are California State Plane Zone III, NAD 83.

Created by Debra Dwyer, San Francisco State University Institute for GISc, May 4, 2002, revised October 12, 2005

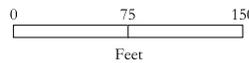
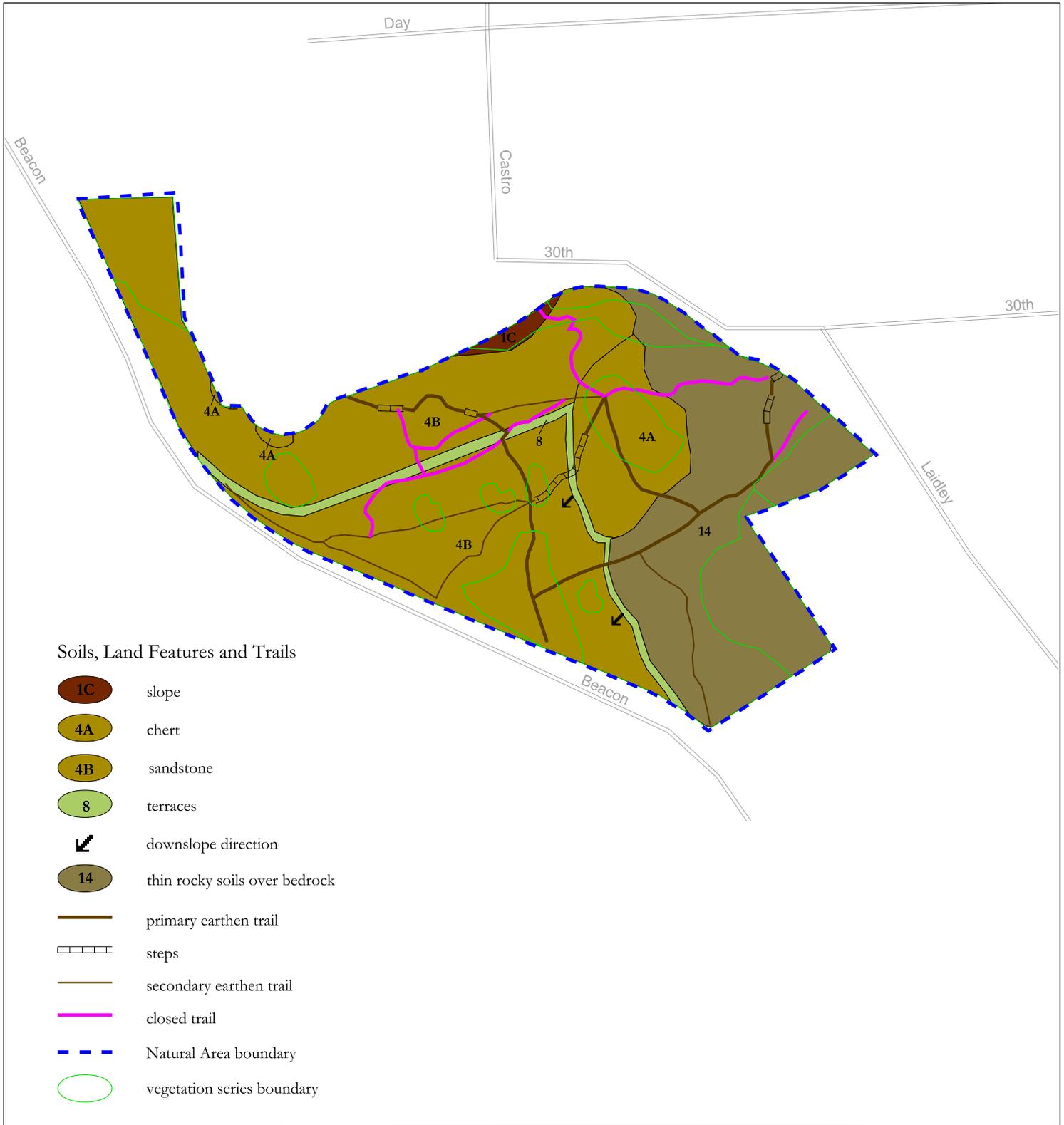


FIGURE 6.9 - 1
AERIAL PHOTOGRAPH,
PROPERTY BOUNDARIES,
AND NATURAL AREAS

Billy Goat
Significant Natural Resource Areas
Management Plan
San Francisco, California



Source: Vegetation data collected by San Francisco Department of Recreation and Parks Significant Natural Areas Program (NAP), San Francisco State University Biology Department, and EIP Associates, 1999-2000; soil and land features data collected by EIP Associates, 1999 - 2002; trails data collected by NAP, 2005; data layers digitized by Geotopo, Inc., 1999 - 2000; edited and corrected by San Francisco State University Institute for GISc (SFSUGIS), 2000, 2005; trails data digitized by SFSUGIS, 2005; natural area boundary created by SFSUGIS from data determined by NAP, 2005; streets data excerpted from ArcView Street-Map 2000 Data, copyright 1998-2000, Environmental Systems Research Institute, Inc. (ESRI).

Created by D. Dwyer, San Francisco State University Institute for GISc, October 16, 2001, revised November 22, 2005.

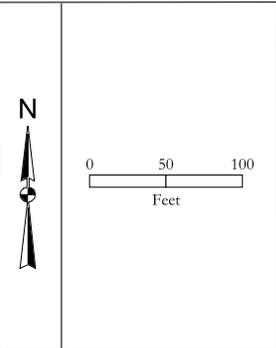
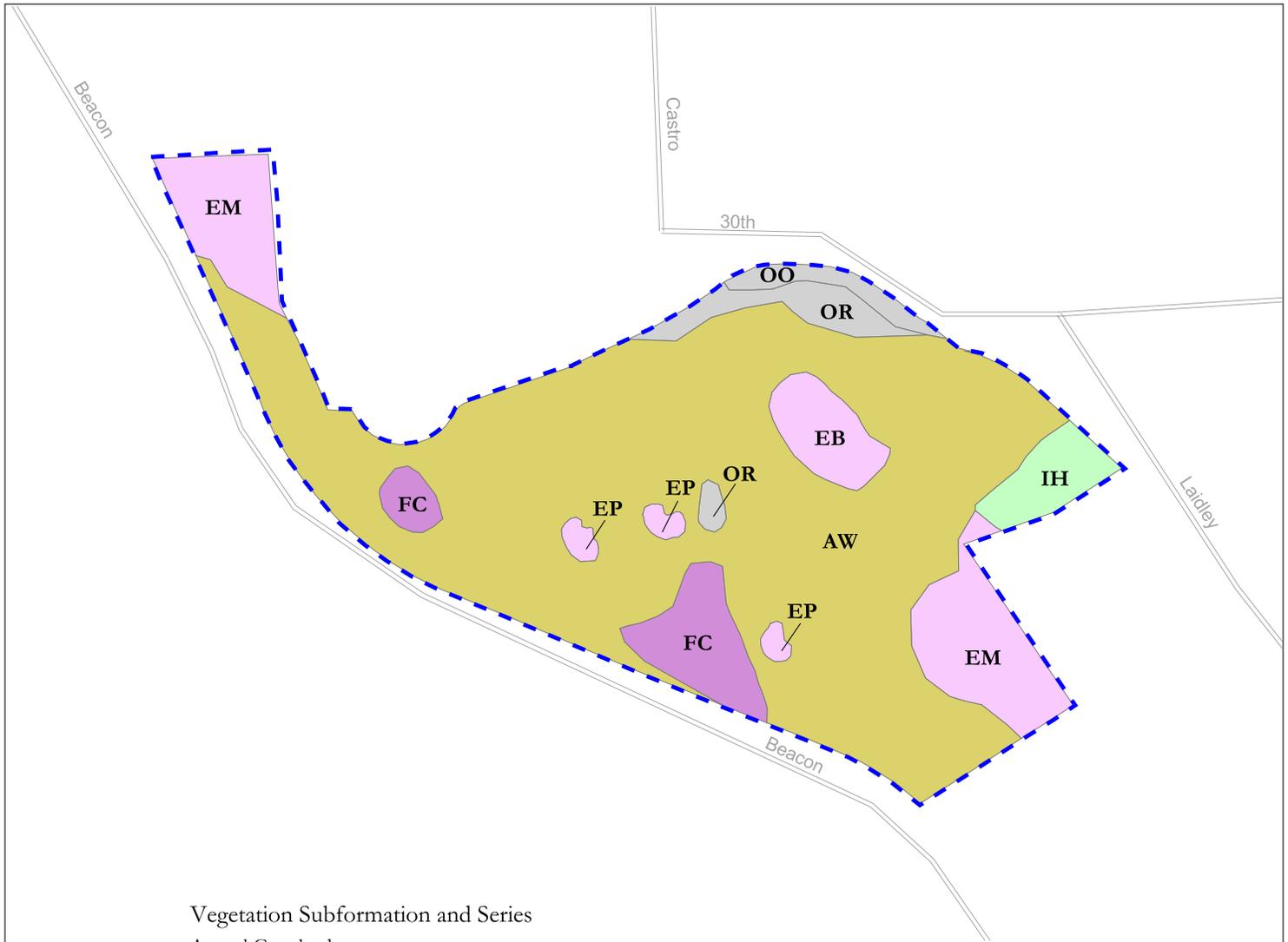


FIGURE 6.9 - 2
SOILS, LAND FEATURES,
AND TRAILS
Billy Goat
 Significant Natural Resource Areas
 Management Plan
 San Francisco, California





Vegetation Subformation and Series

Annual Grassland

AW wild oat grassland

Non-native Forest

EB blue gum forest

EP pine forest

EM mixed exotic forest

Non-native Scrub

IH Himalayan blackberry scrub

Northern Franciscan Coastal Scrub

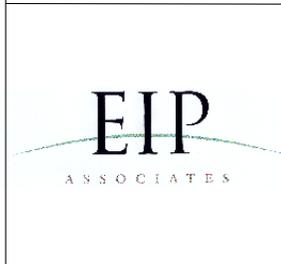
FC coyote brush scrub

Other

OO ornamental

OR rock outcrop

- - - Natural Area boundary



Source: Vegetation data collected by San Francisco Department of Recreation and Parks Significant Natural Areas Program (NAP), San Francisco State University Biology Department and EIP Associates, 1999-2000; data layers digitized by Geotopo, Inc., 2000; edited and corrected by San Francisco State Institute for GISc (SFSUGIS), 2000 - 2002; natural area boundary created by SFSUGIS from data provided by NAP, 2005; streets data excerpted from ArcView StreetMap 2000 data from Environmental Systems Research Institute, Inc., copyright 1998-2001.

Created by D. Dwyer, San Francisco State University Institute for GISc September 10, 2001, revised August 21, 2005.

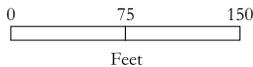
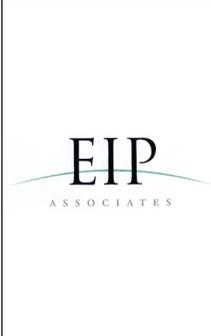
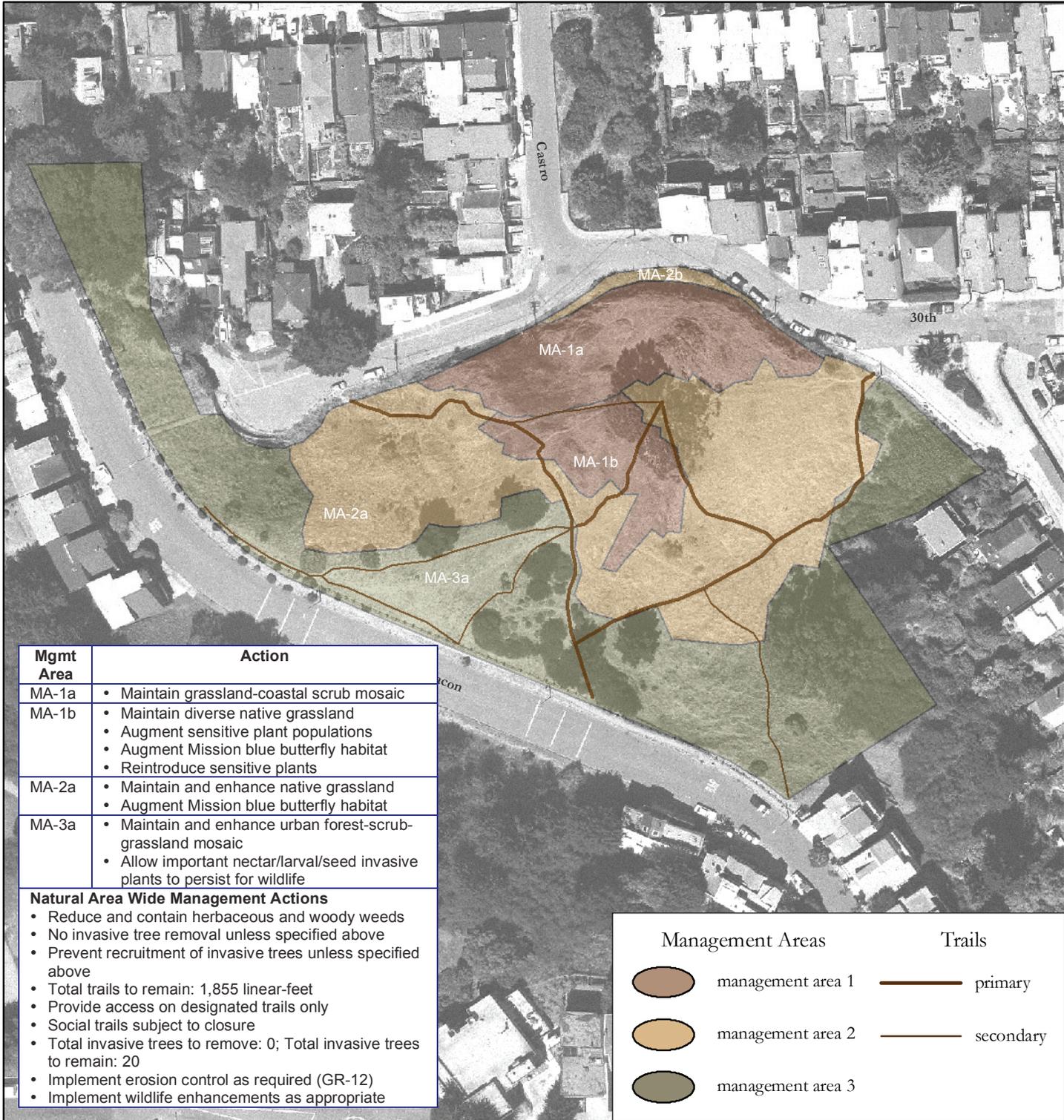


FIGURE 6.9 - 3
VEGETATION
Billy Goat
 Significant Natural Resource Areas
 Management Plan
 San Francisco, California



Source: Management areas and trails data collected by San Francisco Department of Recreation and Park Natural Areas Program (NAP), 2005; trails data digitized by San Francisco State University Institute for GISc (SFSUGIS), 2005; streets data excerpted from Environmental Systems Research Institute (ESRI), Inc.'s Street-Map 2000 data copyright ESRI 1998-2001; aerial photography San Francisco Department of Public Works, 2002, Orthophoto - San Francisco - 1 Foot Resolution - 2001; all data are in California State Plane Zone III projection, NAD 1983; map produced using ArcGIS 9.0 software by ESRI.

Map created May 28, 2005 by Debra Dwyer, San Francisco State University, Institute for Geographic Information Science; revised August 23, 2005.

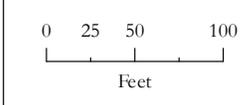


FIGURE 6.9 - 4
MANAGEMENT AREAS AND TRAIL PLAN
Billy Goat
 Significant Natural Resource Areas Management Plan
 San Francisco, California