Title

Restoration Impacts on Lobos Creek: San Francisco's Last Free-Flowing, Perennial, and Unculverted Creek

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Publication Date

2023-10-01

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Final Draft

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Abstract

In 1996, the National Park Service (NPS) restored a 100-yard section of Lobos Creek in San Francisco. In this study, we evaluated the presence of invasive species within the Lobos Creek restoration project. The restoration site is not actively managed by any organization or volunteer group. Our research is unique in that it is a comparison between an unmanaged restoration site and an actively managed area along the same creek. Our project takes into account the historical land use changes within the area to provide context on how plant communities have been impacted. We found that the unmanaged Lobos Creek restoration site has reduced the presence of invasive species, in comparison to the managed and unrestored upstream portions of the creek.

Introduction

Lobos Creek is the last free-flowing, perennial, and unculverted creek in San Francisco (Herrera et al., 2007). Flowing through the southwest corner of the Presidio, through the Presidio Water Treatment Plant, and into the Pacific Ocean at Baker Beach, Lobos Creek forms the Presidio's boundary with the Sea Cliff neighborhood and the Richmond District (Figure 1) (Herrera et al., 2007). It drains about 3 square miles from the Presidio to the northern edge of Golden Gate Park (Hayes, 2010), and its "groundwater basin is made up of shallow unconsolidated alluvium underlain by less permeable bedrock" (Lobos Groundwater Basin Bulletin 118, 2004). The creek is fed by springs primarily along its southern bank between 19th and 21st Avenues (Hayes, 2010). The Presidio and much of San Francisco was covered in sand dunes before the city was paved over and developed, as stated by a Presidio commandant in the late 1840s (Hollaran, 2007). Underneath the sand dunes lies the Colma formation, which is primarily "comprised of nearly flat lying fine-grained sand, silty sand, and occasional clay beds" with impermeable bedrock beneath it (Lobos Groundwater Basin Bulletin 118, 2004). Infiltration by irrigation water and water and sewer pipe leakage contribute to groundwater recharge in the basin in addition to rainwater. In a 1993 report, the total recharge was estimated as 1,570 acre-feet per year with half of the total coming from water and sewer pipe leakage (Phillips et al., 1993).

Overtime, accidental and deliberate introduction of non-native species have threatened native plant communities in the Presidio (Presidio Trust Management Plan, 2002). "All remnant natural communities on the Presidio are vulnerable to invasion by exotic species" (Presidio Trust Management Plan, 2002). "The most invasive exotic plant species currently affecting remnant native habitat include European annual grasses, such as tall fescue, orchard, purple velvet and

ehrharta grasses; Cape, English, and Algerian ivies; oxalis; ice plant and narrow-leafed ice plant; pampas grass; French broom; acacias; prickly ox-tongue; sow thistle; and Italian thistle" (Presidio Trust Management Plan, 2002). The goal of ecological restoration is to restore both natural processes and function which protects special-status plant species and riparian and aquatic habitats that support fauna (Presidio Trust Management Plan, 2002).

In 1995 a sewer line failed causing a sinkhole near Lobos Creek. The sinkhole precipitated slope failure on the southern bank of the creek, just upstream of Lincoln Boulevard. This slope failure plugged Lobos Creek which caused water to pool up behind the landslide and kill off viny vegetation (Fainter, 1996). The area damaged from the slope failure is the site of the Lobos Creek riparian restoration project (Figure 2).

This study pertains to the land use and vegetation changes that have taken place along Lobos Creek. Through historical research we describe native vegetation as it was pre-European contact and how it changed over time under the control of multiple military and government organizations. We compare the upstream portions of Lobos Creek managed by the NPS to the downstream restored portion of the creek, looking for a decrease in the presence of invasive species.

Methods

To determine how the vegetation and land use has changed throughout history, we researched the history of Lobos Creek, conducted field surveys, and consulted NPS biologist Michael Chasse.

History of Lobos Creek

We researched the history of Lobos Creek to better understand the context of the restoration project within the larger history of the creek. We learned that the creek has been a documented drinking water source since the original Spanish exploration of California and likely millenia prior for the indigenous peoples of the area. Although no artifacts have been found in the Lobos Creek Valley dunes or stream channel, artifacts have been found within the Presidio (M. Chasse, NPS, personal communication, November 2023). For example, a serrated obsidian point was found near the creek at a restoration site near Battery Caulfield Road (Hayes, 2010).

We had difficulty finding documentation on the riparian restoration project in particular. We looked through several internet repositories and libraries such as the NPS DataStore and the UC Berkeley Library. We also reached out to NPS and contractor employees to no avail. The "Restoration Plan For Lobos Creek" was the only document we found that was explicitly about the restoration project itself, but about half of the document was missing. This constrained our understanding of the restoration project's goals, methods, and history. Finding broader literature on Lobos Creek was not an issue.

Vegetation Transects

We conducted vegetation 90-foot transects at five sites across the creek, recording the species observed moving laterally away from the creek (Figure 6). We conducted the first three transects upstream of the restoration project. Each transect site outside the restoration project has distinct channel characteristics and distinct vegetation composition. Our two transect sites in the restoration project had very similar channel characteristics and vegetation composition. For our

fifth transect, a fence about 10 feet away from the creek blocked access to the water, but the creek was visible from the fence. We walked the length of the creek as much as possible (i.e., where it was accessible and not overgrown) from the creek's spring-fed source to the mouth at Baker Beach. We observed how the vegetation changed along its 0.80-mile path to the ocean.

Results and Discussion

History of Lobos Creek

Lobos Creek has a long and rich history. Pedro Font, a Franciscan missionary on Juan Bautista de Anza's expedition of 1775 and 1776, named the creek "Arroyo del Puerto" (Font 1776), anticipating its importance to the future port city. To this day, Lobos Creek still serves as the main water supply for the Presidio, providing about 70% of its water (Presidio Trust, 2023). From 1776 until 1994, the Presidio served as a military installation for Spain, Mexico, and the United States owing to its strategic location at the northern tip of the San Francisco Peninsula. In 1994, the Presidio became a part of the NPS's Golden Gate National Recreation Area (Presidio Trust, 1996).

Lobos Creek's channel has changed minimally since it was first seen by Europeans. In his diary, Font writes that Lobos Creek flows from Mountain Lake to Baker Beach (Font, 1776). A 1911 map from the Spring Valley Water Company shows Lobos Creek's channel in the same position as it is today (Figure 2 and 3). In fact, the origins of the channel may be prehistoric. "Geologists have suggested that an ancient stream channel established the above- and below-ground topography of the watershed, and that groundwater still flows along this prehistoric channel and emerges as surface flow in Lobos Creek" (Hayes, 2010).

While Lobos Creek's channel has remained fixed for the observable past, its ecosystem has changed as different people settled the area. Before Spanish arrival, the creek flowed through dunes that covered much of the peninsula before urbanization. The area supported diverse plant communities such as northern foredune, central dune scrub, central coast arroyo willow riparian forest, and central coast live oak riparian forest (Laddish, 1996). Ohlone tribes probably managed and pruned the riparian species, using the willows for basket-making and coast live oak acorns for nutrition (M. Chasse, NPS, personal communication, November 2023). With the European settlement came major alterations to the landscape. Font's diary is replete with references to the utilization of natural resources such as agriculture and logging. This overexploitation led to native plant loss in the dunes and exotic invasive species introduction (Laddish, 1996). Native plant loss was so extreme that even the ubiquitous coast live oak was nearly eradicated from the Presidio due to firewood gathering; one resident even noted in 1854 that "there is scarcely a tree left for ornament or use" (Holloran, 1997). This near extirpation of trees left the Presidio exposed to the prevailing onshore winds and inspired the Army to undertake an ambitious tree-planting program in 1883 (Holloran, 1997). Major W.A. Jones wrote "The main idea is to crown the ridges, border the boundary fences, and cover the areas of sand and marsh waste with a forest that will generally seem continuous, and thus appear immensely larger than it really is" (Holloran, 1997). The Army's massive planting regimen prioritized military strategy and completely neglected endemic ecology. They planted nearly 100,000 trees–mostly blue gum (*Eucalyptus globulus*), Monterey cypress (*Cupressus macrocarpa*), and Monterey pine (*Pinus radiata*)–none of which are native to San Francisco. Furthermore, the

Lobos Creek Valley was used to farm vegetables in the 1870s, a balloon hangar was built in the 1920s, and later a baseball field was built on site.

Though we lack details on the exact distribution of plant species in pre-colonization Lobos Creek, the creek riparian area native vegetation consisted of arroyo willow and live oak riparian forests. The Lobos Creek Dunes hosted the dune scrub ecosystem, and the mouth of the creek at Baker Beach was a foredune ecosystem (Figure 4). Today, the Lobos Creek Valley dunes and riparian areas represent some of the last remaining native plant communities in the Presidio and San Francisco as a whole (Figure 5).

The NPS restored about 100 yards of riparian area immediately upstream of Lincoln Boulevard after the 1995 slope failure (Figure 2) (Fainter, 1996). Due to the limited documentation on the restoration project we deduced that the restored riparian area is the 100-yard-long section of the valley immediately upstream of the Lincoln Boulevard culvert. We cross-referenced the locations of houses A and B in Figure 6 from 1996 and Figure 7 from 2023. As Figures 6 and 8 show, the project removed all vegetation in the area and replanted the creek banks with native riparian species such as willows and oaks. Figure 7 shows the dunescrub growing in the foreground with the riparian species behind the scrub obstructing view of the creek. According to Korotkin Associates, “the plan specified a massive overplanting of native species indigenous to that area, in order to ensure adequate survival rate” (Korotkin Asociates, 2019).

The dune restoration project was conducted as mitigation for the Richmond Transport Project (GGNRA et al., 2001). Additionally the restoration project remedied damage caused by the

December 1995 storm which formed a sinkhole; the sinkhole led to slope failure of the steep southern bank which plugged Lobos Creek upstream from Lincoln Boulevard (Fainter, 1996). The slope failure occurred at the edge of the wealthy Seacliff neighborhood, and its politically-connected residents influenced the NPS to restore Lobos Creek with the help of elected officials like State Senator Quentin Kopp and Congresswoman Nancy Pelosi. The NPS had in fact been focusing on restoring Redwood Creek in Marin County, a much less urbanized creek supporting endangered Coho salmon and steelhead trout populations (Fainter, 1996). Lobos Creek on the other hand supports a single fish species, the three-spine stickleback (Hayes, 2010). In his 1996 report on Lobos Creek, Michael Ryan Fainter claims that the Lobos Creek restoration project was guided more by political interests than ecological objectives.

Vegetation Transects

Figure 2 shows the five vegetation transects we conducted for this study. We took transects 1, 2, and 3 along Lobos Creek upstream of the restoration site. We took transects 4 and 5 in the restoration site. Transect 1 was taken near two 17th Avenue. Transect 2 was taken between 19th Avenue and 20th Avenue. Transect 3 was taken closest to 22nd Avenue. Transects 4 and 5 were taken between 22nd Avenue and 24th Avenue, within the restoration site.

Transect 1 was taken at the headwaters of the creek where the stream is a seep (Figure 9). From 10 to 40 feet, the vegetation assemblage includes lady fern (*Athyrium filix-femina* (L.) Roth), stinging nettle (*Urtica dioica*), California blackberry (*Rubus ursinus*) and Cape ivy (*Delairea odorata).* From 40 to 60 feet the planting includes willow, red elderberry (Sambucus racemosa) and California blackberry (*Rubus ursinus*). Past the fence at the 64-foot mark debris piles of cape

ivy from past restoration efforts can be seen. Plants include panic veldt grass (*Ehrharta erecta*) willow, and toyon (*heteromeles arbutifolia*).

Transect 2 was taken where there is a defined stream channel within a steep ravine (Figure 10). Within the channel itself we found calla lily (*Zantedeschia aethiopica*) and watercress (*Nasturtium officinale*). Within 30 feet of the channel we see polypody fern (*Polypodium californicum*), common vetch (*Vicia sativa*), and grass that we were unable to identify. Within the remaining 60 feet the vegetation includes coast live oak (*Quercus agrifolia*), Cape ivy and oak leaf litter.

Transect 3 was taken where there is a defined stream channel within a moderately steep ravine, compared to transect 2 (Figure 11). From the 10-foot to 20-foot mark, plants include California blackberry, red elderberry, and cape ivy. We found California coffeeberry (*Frangula California*) on this transect but did not see it in other reaches of the creek. The remaining 70 feet included coast live oak, panic veldt grass, and oak leaf litter.

Transect 4 was taken within the restoration site itself, closest to the portion of Lobos Creek managed by the NPS (Figure 12). From the stream channel at zero feet to 21 feet the planting included willow, lady fern, and California blackberry. From 21 to 60 feet the planting included coast live oak, stinging nettle, California blackberry, and willow. The next 60 feet are past the fence separating Lobos Creek from the public. This planted area included coyote brush and coastal buckwheat.

Transect 5 was taken within the restoration site itself, closest to the culvert that passes the stream underneath Lincoln Boulevard (Figure 13). The first 21 feet of the transect included willow, coast live oak, and toyon. There is a small amount of Cape ivy growing up the fence. The remaining 69 feet were dune habitat, consisting of coyote bush, coastal buckwheat, yarrow (*Achillea millefolium*) and lupin.

We argue that the restoration reach of the stream had less invasive species than the upstream portions because of the density of planting, and the removal of previous vegetation as seen in Figure 20. Restoration projects elsewhere, can look to the Lobos creek project as a case study for the effectiveness of high planting density as it pertains to weed suppression. We believe that the elevation changes from the stream laterally have also influenced the vegetation patterns, but this requires further research to prove satisfactorily.

Conclusions

We studied land use and vegetation changes along Lobos Creek. Through historical research we determined that the channel and flow of Lobos Creek has been geomorphically stable since 1776. The vegetation along the creek has been altered due to land use changes and introduced species. Invasive species were seen along vegetation transects upstream of the restoration area, but presence was reduced along the restored portion of Lobos Creek.The restoration project was successful in producing a native plant assemblage while also reducing the presence of invasive species, but not completely eradicating them.

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Figures

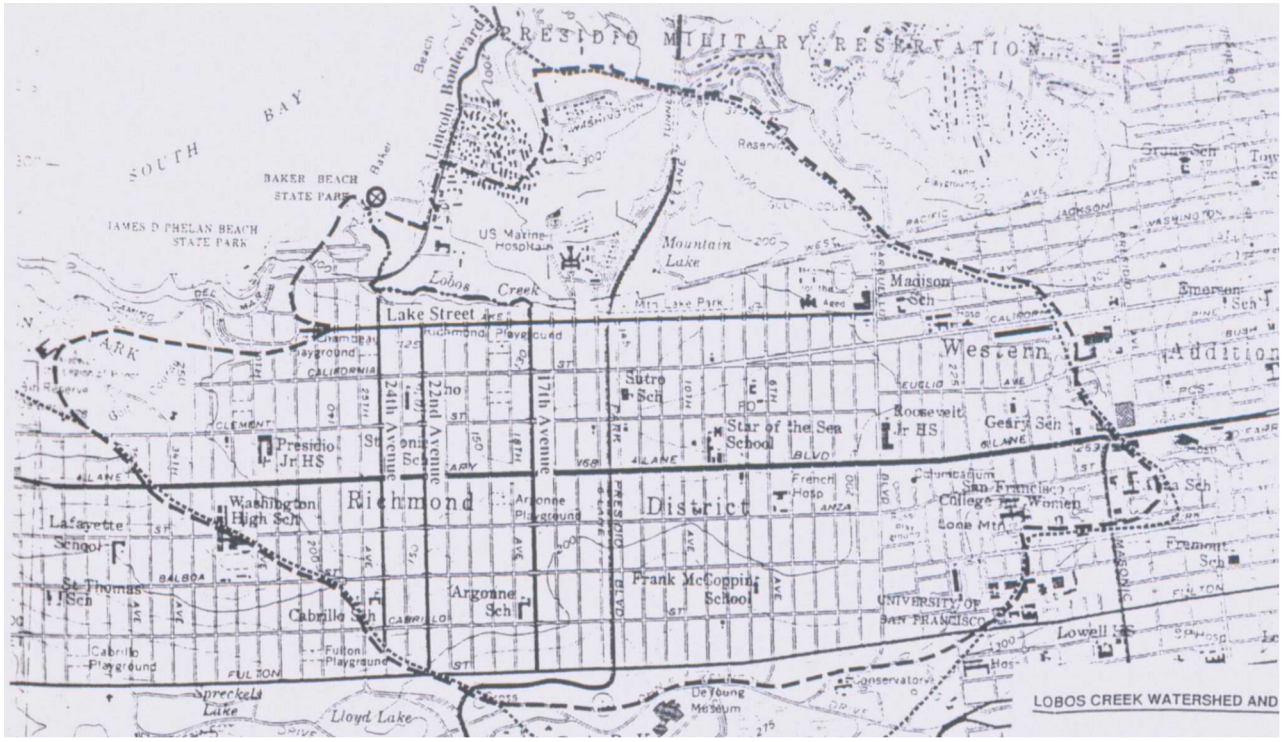


Figure 1: Lobos Creek Watershed (Dames and Moore, 1994).

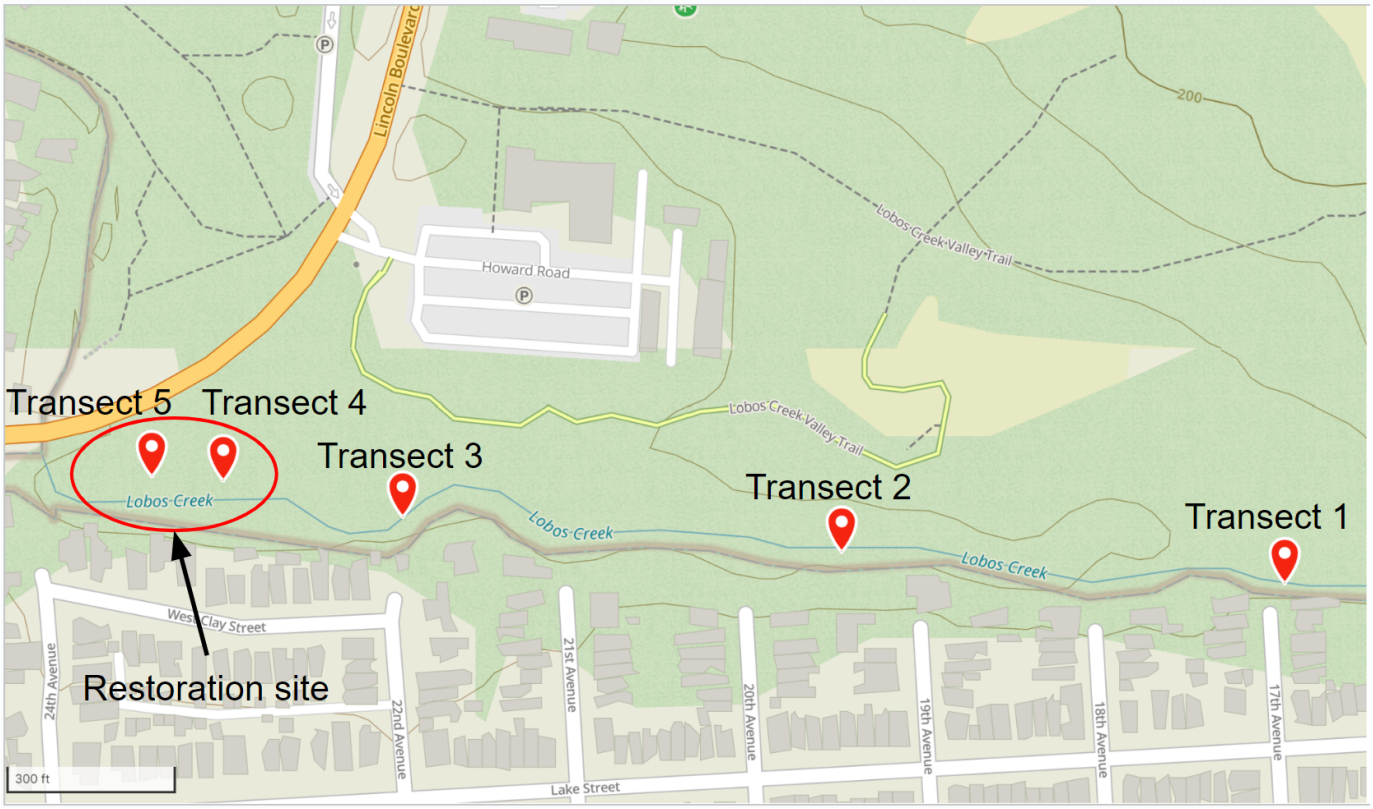


Figure 2: Restoration site and vegetation transect locations on Lobos Creek.

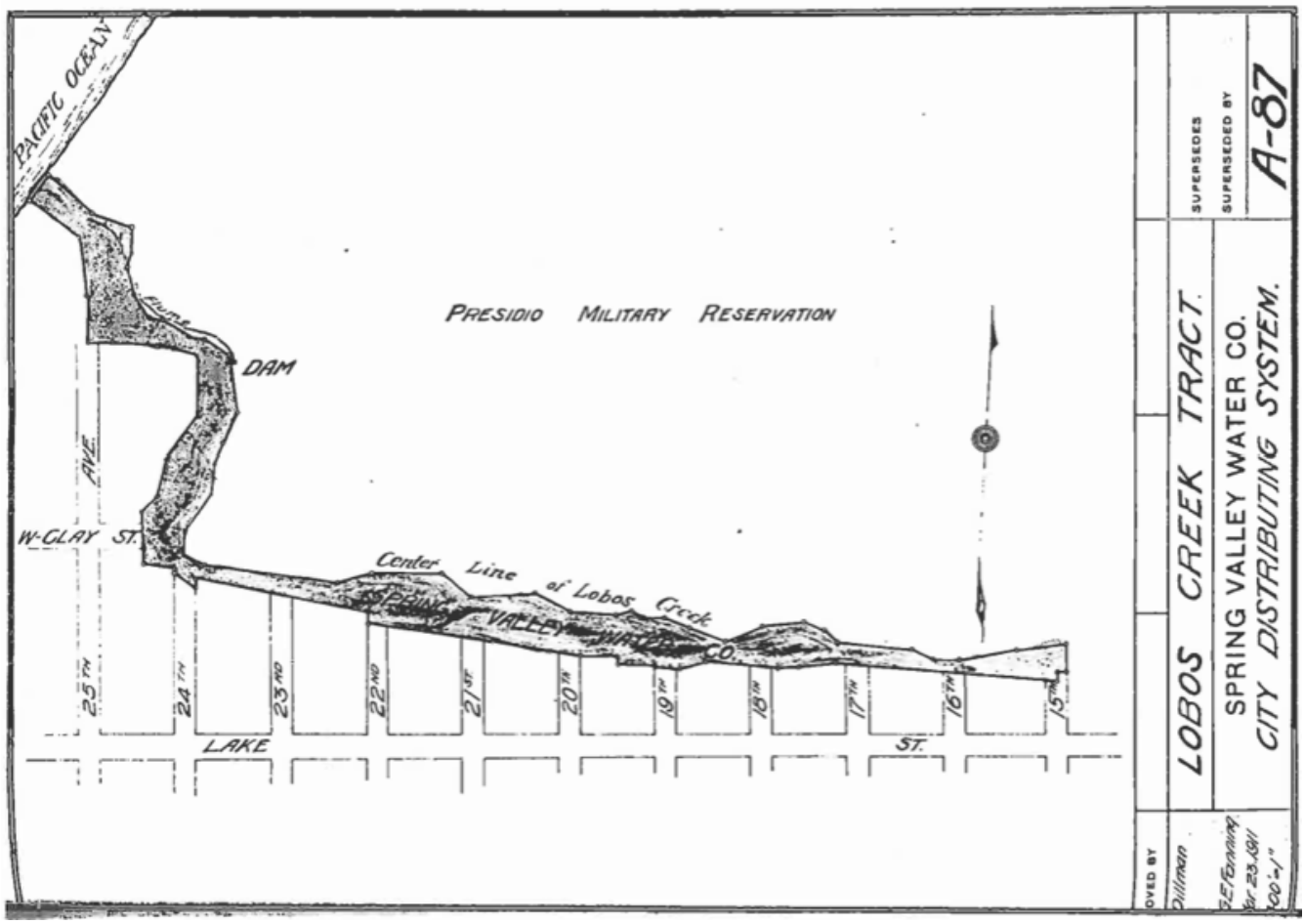
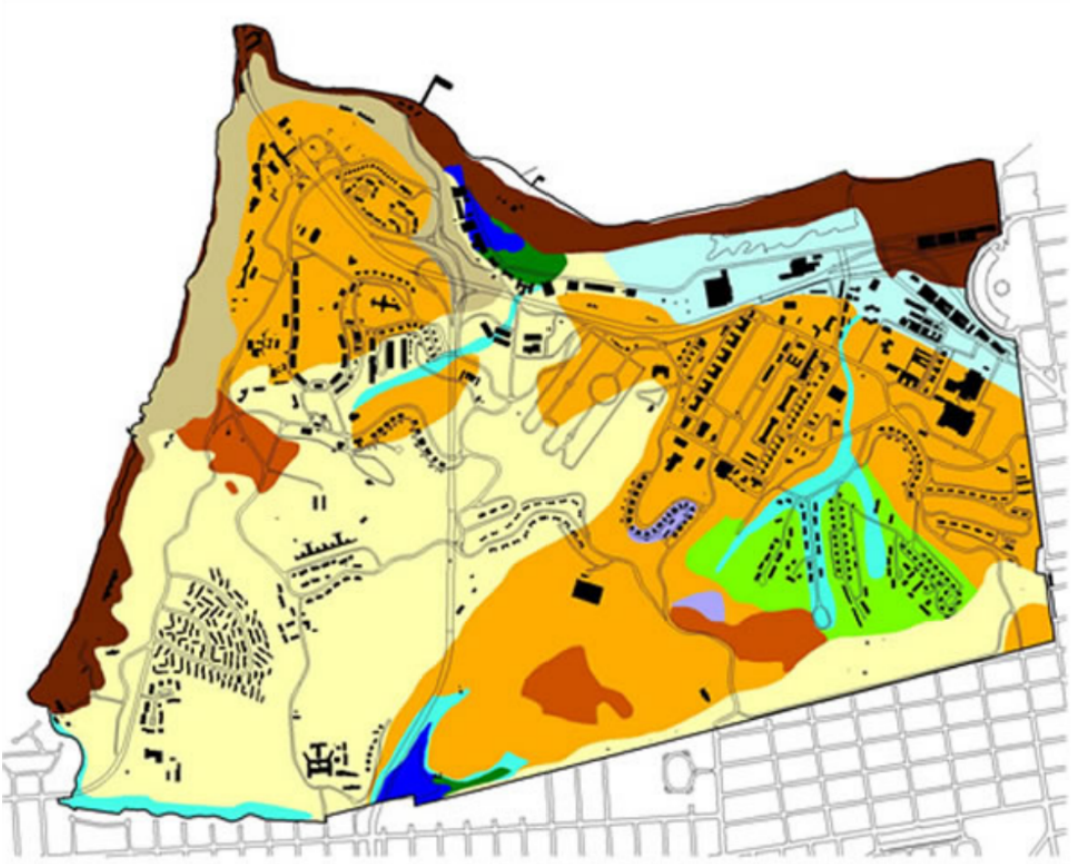


Figure 3: 1911 Lobos Creek Tract (Elliott 1911).



	Foredune
	Dune Scrub
	Bluff Scrub, Coastal Scrub, and Serpentine Scrub
	Coastal Prairie and Coastal Scrub
	Coastal Prairie
	Coast Salt Marsh
	Serpentine Grassland and Serpentine Scrub
	Freshwater Marsh
	Arroyo Willow Riparian Forest and Live Oak Riparian Forest
	Live Oak Woodland and Coastal Scrub
	Open Water
Source: Jones & Stokes Associates, Inc., 1997	

Figure 4: Probable Presidio Native Vegetation Prior to European Settlement (GGNRA et al., 2001).

	WR	Arroyo Willow Riparian Forest
	BS	Bluff Scrub
	CP	Coastal Prairie
	SM	Coastal Salt Marsh
	CS	Coastal Scrub
	DS	Dune Scrub
	F	Foredunes
	FM	Freshwater Marsh
	OR	Live Oak Riparian Forest
	OW	Live Oak Woodland
	RS	Riparian Scrub
	SC	Serpentine Scrub
	SG	Serpentine Prairie
Source: Jones & Stokes Associates, Inc., 1997 and NPS, 2001		

Figure 5: Existing Presidio Native Communities (GGNRA et al., 2001).

Figure 6: 1996 upstream view of Lobos Creek restoration project (Korotkin Associates, 2019)

Figure 7: Looking south on the restoration project from the north bank dunes in 2023.

Figure 8: 1996 view of the north bank of the Lobos Creek during restoration (Korotkin Associates, 2019).

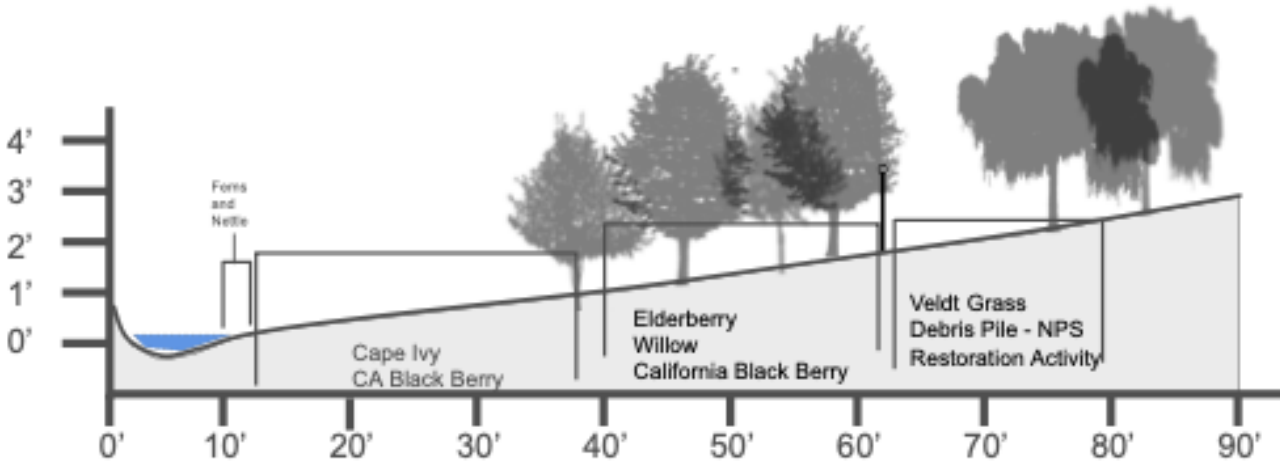


Figure 9: Vegetation transect #1. Headwaters of Lobos Creek between 16th and 17th Avenues.

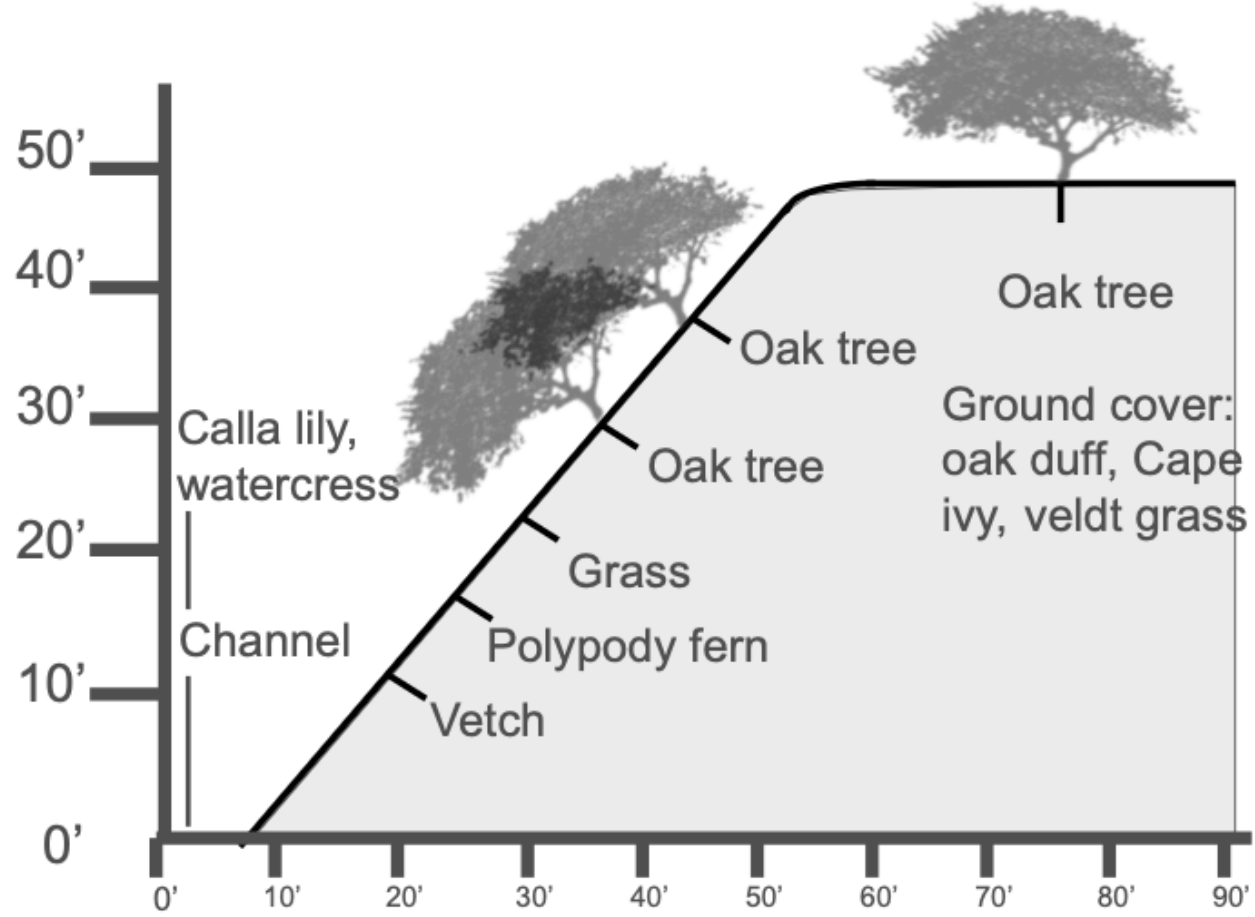


Figure 10. Vegetation Transect #2. Oak Riparian habitat of Lobos Creek between 19th and 20th Avenues.

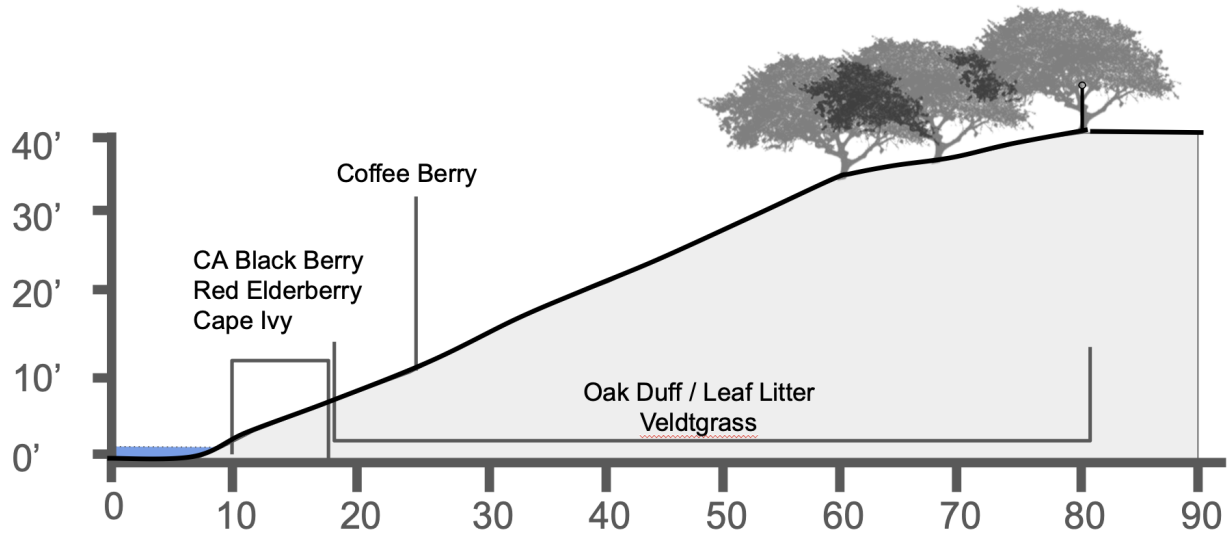


Figure 11: Vegetation Transect #3. Oak riparian habitat of Lobos Creek just east of restoration site.

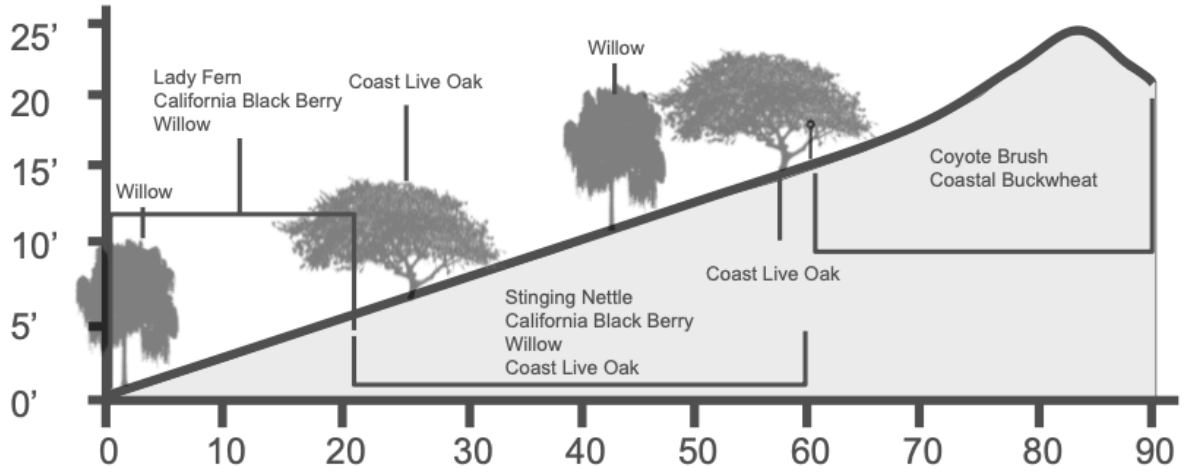


Figure 12: Vegetation Transect #4. Restoration site, Oak and Willow Riparian.

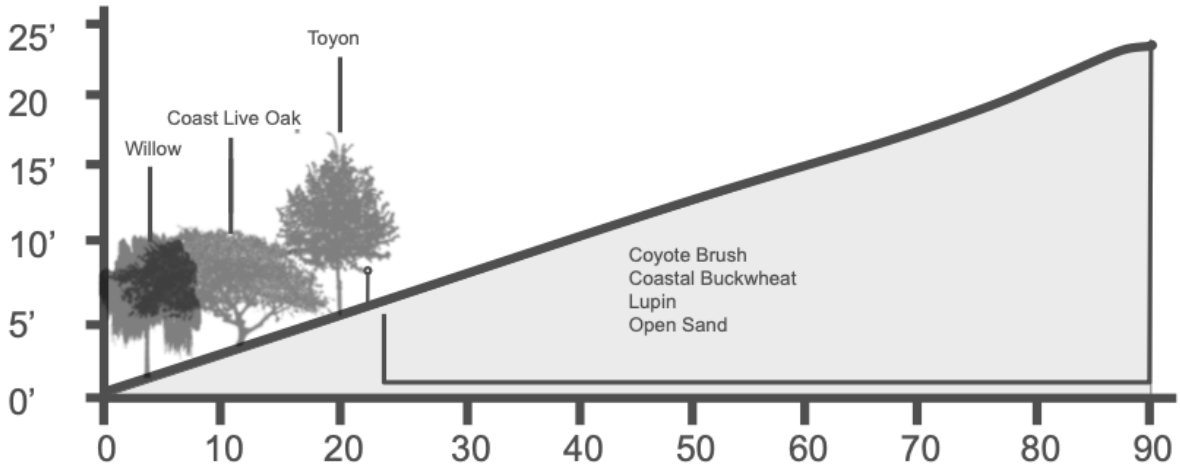


Figure 13: Vegetation Transect #5. Restoration site, Oak and Willow Riparian with Backdune habitat.