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MITIGATION AND MONITORING PLAN
BOAT RAMP WETLAND AND FOUNTAIN THISTLE SITES
SAN MATEO COUNTY, CALIFORNIA

FINAL

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Prepared for:

San Francisco Public Utilities Commission
1155 Market Street
San Francisco, CA 94103

Agreement No. CS-883D

Prepared by:

WINZLER & KELLY
633 Third Street
Eureka, CA 95501

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1.0 INTRODUCTION

1.1 Organization of Document

This Mitigation and Monitoring Plan (MMP) describes part of the Habitat Reserve Program (HRP) the San Francisco Public Utilities Commission (SFPUC) will implement to create and enhance habitat within the Peninsula holdings, located in San Mateo County, California (Figure 1). The HRP focuses on developing consolidated compensation for the series of projects included in the Water System Improvement Program (WSIP). The MMP follows the SFPUC Guidance for Consultants Preparing Mitigation and Monitoring Plans (April 2009 Review Draft) prepared by May and Associates (2009) and, generally, the mitigation and monitoring guidance issued by the U.S. Army Corps of Engineers (USACE, 2004), but has been modified and broadened to include site specific factors and upland habitat.

1.2 Responsible Parties

The applicant is the San Francisco Public Utilities Commission, 1145 Market Street, San Francisco CA, 94103. The contact person is Greg Lyman, (415) 554-1601.

This Mitigation and Monitoring Plan was prepared by Winzler & Kelly, 633 Third Street, Eureka CA, 95501. The lead author is Ken Mierzwa and Stephanie Klein. The contact person is Misha Schwarz, (707) 443-8326.

2.0 PROJECTS REQUIRING MITIGATION

2.1 Location

The habitats proposed in this MMP for preservation, enhancement, restoration and establishment would be used to compensate for unavoidable impacts from SFPUC projects. This MMP may be referenced in permit applications for SFPUC Water System Improvement Program (WSIP) projects and projects not included in the program. SFPUC projects that may reference habitat improvements at the Boat Ramp sites include, but are not limited to Crystal Springs Pipeline No. 2 Replacement, Crystal Springs San Andreas Transmission Upgrade, and Lower Crystal Springs Dam Improvements. Table 1 summarizes the allocation of habitat benefits to various WSIP projects.

Table 1. Water System Improvement Program Projects and Boat Ramp Wetland Creation and Boat Ramp Fountain Thistle Enhancement Sites Benefit

	Serpentine Grasslands - Enhanced	Serpentine Grasslands Re-established	Riparian – Enhanced (CRLF & SFGS Upland Dispersal)	Freshwater Marsh – Enhanced (CRLF & SFGS Breeding and Foraging)	Freshwater Marsh – Established (CRLF and SFGS Breeding & Foraging)	Northern Coyote Brush Scrub (CRLF & SFGS Upland Dispersal)	Other Waters (Seep)
	Acres	Acres	Acres/LF	Acres	Acres	Acres	Acres
Boat Ramp Fountain Thistle Enhancement							
Lower Crystal Springs Dam Improvements	12.5		0.03				0.1
Future WSIP Project	9.7						
Project Implementation	1.39	4.43					
Boat Ramp Wetland Establishment							
Lower Crystal Springs Dam Improvements		0.3			0.10		
Project Implementation		0.08		.045	.021	.22	
Total	23.59	4.81	0.03	.045	0.12	.22	0.1

3.0 PROPOSED MITIGATION SITE

3.1 Location

The three Boat Ramp sites (Boat Ramp Wetland, Boat Ramp Fountain Thistle and Invasive Species Management Area) are included in this Habitat Mitigation and Monitoring Plan. The Wetland re-establishment and the Fountain Thistle sites are less than 100 feet apart, located west of Interstate 280 and Skyline Boulevard, and north of SR 92. The sites are on the east shoreline of Lower Crystal Springs Reservoir at an elevation of approximately 290 to 350 feet, within the central portion of the SFPUC Peninsula holdings. The Boat Ramp Wetland Establishment site is small (less than one acre), and includes part of the existing gravel road from the entrance gate to the boat ramp at Lower Crystal Springs Reservoir, as well as a small existing seasonal wetland basin on the southeast side of the road. The Boat Ramp Fountain Thistle site is immediately to the southeast and from the reservoir shoreline upslope containing less than 6 acres. The Invasive Species Management Site is approximately 22.03 acres and is on the east side of Skyline Boulevard, extending upslope to I-280 and south most of the way toward SR 92. A vicinity map is included in Appendix A, Figure 1; the project area site map is shown in Figure 2.

3.2 Selection Process and Ownership Status

The proposed HRP mitigation sites were chosen because they include or are contiguous with examples of plant community types targeted for mitigation, as well as degraded areas with opportunities to create or expand natural community types. Habitat improvement opportunities includes: approximately 5.99 acres of serpentine grassland re-establishment and 1.02 acres of serpentine grassland enhancement; approximately, 0.17 acres of freshwater wetland establishment and 0.05 acres of freshwater wetland enhancement in the wetland area. The project will include invasive removal and control, within all boundaries of the project site. The sites also could potentially support populations of targeted endangered species, including, fountain thistle (*Cirsium fontinale* var. *fontinale*), Crystal Springs lessingia *(Lessignia arachnoidea)*, and Marin dwarf flax (*Hesperolinon congestum)* which are likely to benefit from habitat improvements. The proposed mitigation sites are owned by SFPUC.

3.3 Existing Conditions

The proposed HRP mitigation sites are owned and operated by the SFPUC for water supply protection. Existing conditions at the Boat Ramp sites are described below.

3.3.1 Jurisdictional Areas

A map of jurisdictional wetlands at the Boat Ramp sites (ESA, 2009) is included as Figure 4. Wetlands are associated with the margin of Lower Crystal Springs Reservoir, with a small existing basin at the Boat Ramp Wetland site, and with man-made sediment basins east of Skyline Boulevard. Seeps associated with stands of fountain thistle fall within State wetlands jurisdiction.

3.3.2 Functions and Values

The proposed HRP mitigation sites are within the Peninsula Watershed, which includes Upper Crystal Springs Reservoir, Lower Crystal Springs Reservoir, San Andreas Reservoir, several streams which flow into the reservoirs, and most of SFPUC's holdings in San Mateo County

(Figure 1). The SFPUC's mission for managing the Peninsula Watershed is to provide the best environment for the production, collection, and storage of the highest quality water for the City and County of San Francisco and other wholesale customers. The SFPUC seeks to accomplish this by developing, implementing, and monitoring a resource management program which addresses all watershed activities. The watershed management program will apply best management practices for the protection of water and natural resources and their conservation, enhancement, restoration, and maintenance while balancing financial costs and benefits (SFPUC 2008). Thus, as a part of the SFPUC-managed Peninsula Watershed, water quality protection is a primary function of the Project Area.

Other functions of the proposed HRP mitigation sites include habitat for several endangered, threatened or sensitive species. The Boat Ramp sites are in proximity to known occurrences of the federally threatened California red-legged frog (*Rana draytonii*) and the federally endangered and state fully protected San Francisco garter snake (*Thamnophis sirtalis tetrataenia*). One of the few remaining populations of federally endangered fountain thistle and a special status rare plant, the Crystal Springs lessingia, occurs throughout the site. The dwarf Marin flax has also been reported in close proximity to the site boundary (ESA, 2009).

Other sensitive species of concern known to occur within the site or in the general vicinity include the western pond turtle (*Actinemys marmorata*) and the San Francisco dusky-footed woodrat (*Neotoma fuscipes annectans).*

3.3.3 Topography and Hydrology

The Boat Ramp sites are located on a gentle west-facing slope on the eastern shoreline of Lower Crystal Springs Reservoir. Although groundwater flow was probably altered by the construction of Interstate 280, seepage is evident at the cut bank at the reservoir shoreline, and at localized locations on the slopes. There is an existing intermittent creek trending east to west through the center of the wetland establishment site towards Lower Crystal Springs Reservoir. Surface flow is evident along the existing gravel road to the boat ramp, and through an existing culvert under the road. Existing topography is shown in Figure 3.

Three watersheds (WS-1 through WS-3) provide water to the Boat Ramp wetland establishment project area, having a total area of approximately 63 acres. Landuse for the sub-watersheds include shrub land and grassland. The runoff from WS-3 flows to the intermittent stream by sheet flow, where it is collected and conveyed toward the proposed wetland area. Runoff from WS-1 and WS-2 is collected and conveyed by a system of pipes that were built by Caltrans during the construction of Highway 280 (HWY 280). Runoff from watersheds WS-1 and WS-2 is collected and routed under the highway to a main conveyance pipe that discharges into the intermittent creek and is conveyed towards Lower Crystal Springs. It is assumed that runoff from HWY 280, for a storm event as large as the 100-year, is self contained through the drainage system.

A jurisdictional wetland delineation map is shown in Figure 4 and the hydrological basemap is shown in Figure 5 and detailed hydrology information is included in Appendix F.

3.3.4 Geology and Soils

The HRP Peninsula Region study area is located within the Coast Ranges Geomorphic Province of California. It is situated on the northern and eastern foothills of the Santa Cruz Mountains, Montara Mountain, and within the San Andreas Fault Zone. The active trace of the San Andreas

Fault goes directly through the San Andreas and the Upper and Lower Crystal Spring Reservoirs in a northwesterly direction; resulting in a number of ridges, valleys, and streams with the same orientation. Some prominent physical features west of the San Andreas Fault include Fifield Ridge, Sawyer Ridge, Cahill Ridge, Sweeney Ridge, and Montara Mountain; east of the San Andreas Fault are Buri Buri Ridge and Pulgas Ridge.

Geology

Bedrock within the HRP Peninsula Region consists of sheared and faulted greenstone, sandstone, serpentinite, Franciscan mélange and chert. Most noteworthy for biological resources are areas of serpentinite (a greenish to bluish-gray metamorphic rock high in magnesium and iron). An area of serpentinite extends for approximately 6 miles along the eastern side of Upper and Lower Crystal Springs Reservoir and several narrow strips extend for approximately 2 miles between San Andreas Reservoir and Pilarcitos Lake. West of the San Andreas and Upper and Lower Crystal Springs Reservoirs bedrock consists mostly of sandstone, shale, and conglomerates, with granitic deposits associated with Montara Mountain.

The Boat Ramp Wetland Establishment and Boat Ramp Fountain Thistle Enhancement areas are located within a large continuous area of serpentinite on the southeast side of Lower Crystal Springs Reservoir. The eastern boundary of the sites is the active trace of the San Andreas Fault at the Reservoir's shoreline. Several narrow areas of artificial fill (loose to consolidated gravel, sand, silt, clay, organic matter and construction debris of various combinations) also exist ranging from approximately 200 to 1,600 feet long between Skyline Boulevard and the Lower Crystal Springs Reservoir. Several small blocks (approximately 150 feet by 250 feet) of sandstone and other metamorphic rock outcrops have been mapped within the Boat Ramp Fountain Thistle Enhancement area.

Soils

The Soil Survey maps the majority of the Boat Ramp Fountain Thistle site as "Obispo clay, 15 to 30 percent slopes" [Soil Map Unit 120] with a thin strip of "Orthents, cut and fill-Urban complex, 5 to 75 percent slopes" [Soil Map Unit 124] associated with the paved road to the northeast of the site (Soil Survey Staff, 2009). The entire Boat Ramp Wetland Establishment site as well as existing access road and proposed staging area is mapped as Soil Map Unit 120 (Obispo clay). Specific soil characteristics of the Obispo series are discussed below.

Obispo clay soils (clayey, magnesic, thermic Lithic Haploxerolls) are on hilly to very steep foothills and mountains and with slopes of 15 to 75 percent. They formed in residual material weathered from serpentinite at elevations of 200 to 2,500 feet, and underlain by serpentinite. These soils are shallow with lithic contact at 8 to 20 inches. These soils are well-drained upland soils, with rapid and very rapid runoff; and slow permeability. According to notes in the soil survey, seep areas adjacent to rock outcrops may persist for several months after the end of the rainy season. These soils are found closely associated with the San Andreas Rift Zone. Obispo clay, 15 to 30 percent slopes [Soil Map Unit 120] have the following land management ratings:

- The land capability for non-irrigated crops on Obispo soils is 7e which indicates severe limitations, generally unsuitable for cultivation and restricting use to mainly pasture, rangeland, forestland, or wildlife habitat. The Storie Index is Grade Five (Very Poor), indicating soils are subject to little erosion but have other limitations that restrict their use to mainly pasture, rangeland, forestland, or wildlife habitat.

- Obispo soils are rated Poor for clay liner material source due to hard pack, thin/shallow soils, small stones, and/or large stones.

- These soils are rated Severe for construction limitations for haul roads and log landings due to slope and depth to lithic contact (within 1.0 feet of the surface).

- The erosion hazard for Obispo soils is Moderate (slope erodibility numeric value of 0.50) for off road/off-trail areas after disturbance activities that exposed the soil surface (limitations due to slope). This hazard increases to Severe (slope erodibility numeric value of 0.95) for soil loss from unsurfaced road/trails. The numeric value indicates gradations between the point at which a soil feature has the greatest negative impact on the specified aspect of forestland management (1.00) and the point at which the soil feature is not a limitation (0.00).

- Soil rutting hazard is Severe due to low strength for the hazard of surface rutting through the operation of forestland equipment. Soil displacement and puddling (from soil deformation and compaction) may occur simultaneously with rutting.

- These soils are moderately suited for hand planting due to stickiness/high plasticity.

- The Obispo soils are rated Poorly Suited for use as log landings due to slope and low soil strength.

- These soils are rated Very Limited for aquifer fed excavated ponds due to depth to permanent groundwater (although site hydrology is being collected in support of pond design at the proposed wetland establishment and fountain thistle enhancement area, and on the micro-scale, the proposed wetland establishment site is known to already support some wetland characteristics).

3.3.5 Vegetation

The Boat Ramp sites include a variety of community types, summarized below by site. Existing plant communities are shown in Figure 7.

The Boat Ramp Wetland Establishment site centers on a small wetland depression mapped as vernal marsh (ESA, 2009). The depression holds only shallow water for relatively short periods of time, with drainage through a culvert under the road into a ravine with riparian scrub on the down gradient side of the road. The vernal marsh is predominately perennial native plants including spikerush (*Eleocharis macrostachya*), and common monkeyflower (M*imulus guttatus*), with a variety of dense sedges and rushes. A California Native Plant Society (CNPS) listed 1B.2 rare plant, the Crystal Springs lessingia occurs on both the east, and west side of the wetland area. Northern coyote brush scrub with coyote brush *(Baccharis pilularis)* and poison oak *(Toxicodendron diversilobum)* surrounds the wetland basin, with a few scattered Monterey pines *(Pinus radiata*) and coast live oaks (*Quercus agrifolia*).

Serpentine grasslands surround this area in both north and south directions supporting a CNPS rare plant, with the status 1B.2, the Crystal Springs lessingia. The Federally threatened, State listed endangered and CNPS rare plant 1B.2 status is the Marin dwarf flax (, which is located approximately 50 feet, outside of the project area, near the southern boundary of the project site, where it coincides with the southern limit of the fountain thistle area (Figure 7b). Approximately 50 feet from the wetland area on the west side of the access road is a small colony of San Mateo

woolly sunflower *(Eriophyllum latilobum).* Additional CNPS rare 1B.2. plants include Fragrant fritillary (*Fritillaria liliacea Lindl.),* and the San Mateo thornmint (*Acanthomintha obovata ssp. duttonii*) which also have potentially suitable habitat in this area and were all reported nearby across interstate 280 and a short distance to the southwest (ESA + Orion, 2009).

Non native plants have been found in this project area and include: Monterey pine, Harding grass (*Phalaris aquatica*), velvet grass *(Holcus lanatus)* and teasel *(Dipsacus sativus)*. Pampas grass (*Cortaderia sp.)* has been recorded within 100 feet of the wetland enhancement/establishment area and is considered to be spreading rapidly.

The adjacent Boat Ramp Fountain Thistle, grassland enhancement site includes extensive areas of diverse serpentine bunchgrass grasslands including but not limited to: hummocks of perennial California hairgrass (*Deschampsia cespitosa ssp. holciformis*) a dominant plant covering 50% of the serpentine grassland seep area and is associated with the fountain thistle, with other dominants being fountain thistle, soap plant (*Chlorogalum pomeridanum*), meadow barley (Hordeum *brachyantherum*), field sedge (*Carex pansa*), short-scale sedge (*Carex deweyana* ssp. *leptopoda*), blue-eyed grass (*Sisyrinchium bellum*), and white brodiaea (*Triteleia hyacinthina).* Scattered individuals of purple needle grass (*Nasella pulchra*), California buttercup (*Ranunculus californica*), common lomatium (*Lomatium utriculatum*) and Delphinum are the less dominant plants identified.

The adjacent to the active areas of restoration and mitigation are serpentine grassland dominants (65% cover) include: Purple needlegrass, blue-eyed grass, blue wild ryegrass (*Elymus glaucus*), California oatgrass (*Danthonia californica*), common lomatium, harvest brodiaea (*Brodiaea elegans*), Fremont's death camas (*Zigadenus fremontii*). Sub-dominants (30%): Annual ryegrass (*Lolium multiflorum*), common yarrow (*Achillea borealis*), annual cat's ear (*Hypochaeris glabra*), owl's clover (*Orthocarpus luteus*) and soft chess (*Bromus hordeaceus*). The remaining surface area was approximately five percent bareground.

A stand of non-native Monterey pine dominates the site. An extensive population of fountain thistle begins near the reservoir edge and extends upslope into the open edge of the pines. Additional observations include Sandburg bluegrass (*Poa secunda*), western blue-eyed grass (*Sisyrinchium bellum*), and common yarrow (*Achillea millefolium*). Woody plants have been observed in the understory of Monterey pine including an evergreen shrub- toyon *(Heteromeles arbutifolia).* Small areas of coast live oak woodland and northern coyote brush scrub consist of coast live oak, coyote brush and poison oak. The riparian scrub on this site has arroyo willow (*Salix lasiolepis*), and common elderberry (*Sambucus nigra ssp. canadensis*), and there is a freshwater seep facilitating the hydrologic habitat needs for the fountain thistle plants (ESA, 2009).

Special status plants have been reported in or close to the pine removal project area: Crystal Springs lessingia was observed in the grasslands immediately adjacent to the Monterey Pine removal area and may extend into it; fragrant fritilary has been reported in the serpentine bunchgrass a few hundred feet north of the area, and suitable habitat is present near and possibly within the area; The dwarf Marin flax was recently reported in a memorandum, with observations of the San Mateo thornmint, in or near the area (ESA + Orion, 2009; Niall McCarten, 2010). The memorandum is located in Appendix F.

In addition to Monterey pine, pampas grass is a non-native invasive species which is encroaching on fountain thistle habitat along the reservoir edge, and in the upper part of the site, above Skyline Boulevard. Additional invasive species on this site include: French broom (*Genista monspessulana*), fennel (*Foeniculum vulgare)*, Harding grass, cotoneaster *(Cotoneaster franchetti),* yellow star thistle (*Centaurea solstitialis)*, teasel, and tocalote (*Centaurea melitensis*). These will be described in more detail in Section 6 of this plan.

3.3.6 Present and Historical Uses of Mitigation Area

The HRP sites are presently maintained as open space within a larger area maintained by SFPUC as part of a water supply watershed. Small roads or trails pass close to the sites. Prior to acquisition by the City of San Francisco some of the sites were used for grazing, light agriculture, or other relatively low-intensity purposes.

3.3.7 Present and Proposed Uses of Adjacent Areas

Adjacent areas are managed as open space and for water supply protection. No changes in land use are proposed.

4.0 CHARACTERISTICS OF REFERENCE SITES

4.1 Location

Reference sites are located within SFPUC Peninsula Watershed holdings, and are shown on Figure 8. Summary descriptions are provided below, and more detailed information is included in Appendix G. Reconnaissance surveys were conducted on December 12, 2008 by NRM Environmental, with more detailed sampling by Winzler & Kelly on April 7-9 and May 6-7, 2009.

4.2 Selection Process

Potential reference sites for each major community type to be enhanced, restored, or established were initially identified by SFPUC in consultation with NRM and Winzler & Kelly. NRM then conducted rainy season reconnaissance visits of each site, and produced a technical memorandum which assessed the suitability of each site and provided an overview description of vegetation and topography (NRM, 2008). NRM determined that most of the sites would be suitable reference sites, in the sense that they reasonably represented target conditions for the community type and were in landscape positions relatively similar to those of the HRP sites. NRM suggested seeking out better examples of certain community types, most notably examples of semi-permanent wetland and grassland. As part of expanding reference sites to encompass restoration targets at HRP sites, Winzler & Kelly and Swaim Biological identified more suitable semi-permanent wetland and valley needlegrass grassland sites. Reference sites are briefly described below, based on April and May site visits and preliminary sampling by Winzler & Kelly. A technical memorandum characterizing reference sites in greater detail is included as Appendix G, and reference site locations can be viewed in Figure 8. Reference sites are being used to guide design, and not for success criteria which are instead based on features found on the project sites.

4.3 Reference Site Descriptions

4.3.1 Riparian Forest Reference Sites

Two riparian reference sites (R-1 and R-2) were characterized. However, riparian communities at these sites are limited to the area below the Boat Ramp wetland, and are not part of the project or this MMP.

4.3.2 Oak Woodland Reference Site

One coast live oak (O-1) and one mixed oak woodland reference site (O-2) were visited. Coast live oak woodland is present only in small parts of the periphery of the fountain thistle site, where some limited enhancement will occur consisting of invasive species removal.

4.3.3 Serpentine Bunchgrass Reference Site

Three serpentine bunchgrass sites were visited, with one of them (S-2) immediately adjacent to and specifically intended to act as a reference site for the Boat Ramp Fountain Thistle site. This site is located immediately south of the pine stand and between Lower Crystal Springs Reservoir and Skyline Boulevard. The site is a gentle west facing slope with rocky serpentinite soil. The dominant and subdominant plants that were discernible included squirrel tail (*Elymus elymoides*), blue wildrye (*Elymus glaucus*), soap plant (*Chloragulum pomeridianum*), blue-eyed grass (*Sisyrinchium bellum*), and tarweed (*Holocarpha* sp.). This site is an excellent reference site because it is contiguous with the project area, with the same slope aspect and elevation, and is of good natural quality.

4.3.4 Seasonal Wetland Reference Site

One reference site (W-2) was visited, a sag pond, located adjacent to Old Cañada Road. The pond was dry in December, and with shallow (about six inches) water present in April and May. The entire pond is densely vegetated and is dominated by spikerush (*Eleocharis* sp.). The southern boundary is dominated by rushes (*Juncus* sp.) and the northern boundary is dominated by wildrye (*Leymus triticoides*). The surrounding upland area includes coast live oak to the west and coyote brush to the east.

Numerous Pacific tree frog (*Pseudacris regilla*) tadpoles and recent metamorphs were observed at this pond on May 6, 2009. This information is important for the design of seasonal wetlands at HRP sites, because successful recruitment of this species is an important factor in ensuring an adequate prey base for juvenile San Francisco garter snakes.

Site W-2 will serve as a reference site for the Boat Ramp wetland site.

4.3.5 Semi-permanent Pond Reference Site

One reference site was visited for the semi-permanent pond habitat. This site is located south of San Andreas Reservoir, and west-southwest of the terminus of Trousdale Road at Interstate 280. It is immediately adjacent to reference Site S-3. The pond provides habitat for both California red-legged frog and San Francisco garter snake (K. Swaim, pers. comm., and verified in the field by Winzler & Kelly in April and May of 2009). This reference site is larger, deeper, and more permanent than the proposed Boat Ramp wetland.

The reference sites are not intended to be tied to success criteria, rather they are intended as resources to document habitat structure and composition; reference sites may be used to guide

design, and for potential post-construction comparison in the event that adaptive management is required.

4.4 Jurisdictional Areas

Formal delineations have not been completed at any of the reference sites. However it is assumed that the seasonal wetland, semi-permanent pond, and riparian sites include potentially state and federal jurisdictional wetland areas. The grassland and oak woodland sites are assumed to be entirely or predominantly upland, although wetlands are sometimes present as inclusions within these community types.

The reference sites serve a variety of functions and values, including protection of water quality within the Peninsula Watershed and providing habitat for wildlife species including several endangered or sensitive species.

5.0 MITIGATION PROPOSAL

5.1 Basis for Design

The goal of the HRP mitigation is to develop self-sustaining natural habitats and consolidate compensation for a variety of projects at one location to maximize overall habitat functions and values. The consolidation of compensation for several SFPUC projects will allow simultaneous development of multiple natural community types to create a functioning ecosystem. At the Boat Ramp sites, specific goals are to provide mitigation for Federal and State listed species, especially the fountain thistle and waters of the U.S. and waters of the State.

The Projects are intended to enhance and establish a seasonal wetland, and reestablish and enhance serpentine grassland which should yield the expansion of more available fountain thistle habitat. Small areas of existing northern coyote bush scrub and coast live oak woodland will be preserved. There are a few scattered oaks within the project area at the extreme north (along the access road) and southeast (next to Skyline Blvd) limits of the site. There are also some oaks above Skyline Blvd which have not been accurately mapped, but generally are toward the north and south ends. None will be impacted, except possibly one oak right next to the wetland which is only a few feet from active equipment use.

These areas provide habitat for several protected species including the federally threatened and state endangered/fully protected San Francisco garter snake, *Thamnophis sirtalis tetrataenia* (SFGS), and the federally threatened California red-legged frog, *Rana draytonii* (CRLF). Prior to Euro-American settlement some of these habitat types were more widespread in San Mateo County. Today these habitats are greatly reduced in extent and fragmented by development and successional changes. Nearby best-remaining examples of similar natural communities were identified as reference sites, and served as the basis for mitigation design and development of the planting palette. The design concept is based on construction beginning in the late summer of 2011.

5.2 Project Goals

An overall goal of the Boat Ramp site projects is to consolidate habitat establishment, restoration and enhancement activities at one location to mitigate impacts from multiple projects. General goals include:

1. Maintain or restore native biodiversity, resulting in a net gain of good quality native habitat;
2. Maintain or enhance the fountain thistle populations, Cristal Springs lessingia populations, and additional sensitive species and their habitats;
3. Maintain, restore, or mimic ecological processes, to the extent practicable;
4. Increase the area of native serpentine bunchgrass grassland habitat;
5. Increase the area of seasonal wetland

5.3 Target Habitats

Plant community types to be established, restored, or enhanced include serpentine grassland and vernal marsh (seasonal wetland).

5.4 Target Species

The long term goals above have been identified based on an analysis of habitat requirements of the target species, including San Francisco garter snake, California red-legged frog, fountain thistle, Marin dwarf flax and Crystal Springs lessingia (Table 2); optimal native plant community compositions, essential ecosystem processes to maintain the habitat and plant communities, and long-term self-sustainability.

Table 2. Boat Ramp Wetland and Thistle Sites Target Species

Common Name	***Scientific Name***	**Status**
Amphibians/Reptiles		
California red-legged frog	*Rana draytonii*	FE
San Francisco garter snake	*Thamnophis sirtalis tetrataenia*	FT/SE
Plants		
fountain thistle	*Cirsium fontinale* var. *fontinale*	FE
Marin dwarf flax	*Hesperolinon congestum*	FT/ST
Crystal Springs lessingia	*Lessingia arachnoidea*	CNPS Rare 1B.2
FT= Federally Threatened; FE= Federally Endangered; SE= State Endangered; ST= State Threatened;		

The target species were selected because of their federal or state protected or sensitive status, and because as sensitive species they serve as indicators of overall community and ecosystem level quality.

The following accounts summarize known habitat needs and other relevant information for the species identified above. Nomenclature follows CDFG (2008).

Fountain thistle (*Cirsium fontinale* var. *fontinale*) (Federally and State Endangered)
This plant is a federally and state listed endangered species. The California Native Plant Society lists this plant as rare under status 1B (rare or endangered throughout its range). This plant was in the Final Recovery Plan for Serpentine Soils of San Francisco Bay Area, in September of 1998; with a 5-Year Review just recently started in March of 2009. Currently this plant is only found in four different locations within San Mateo County; though it was historically recorded in Santa Clara County as well.

The fountain thistle is a stout, erect perennial herb in the aster family. The stems have spiny lobes at their tips, are reddish in color, and can grow up between 1-2 feet and the basal leaves can be up to 8 inches long, usually no shorter than 4 inches long. During the initial blooming, blooms are white to pinkish, losing their color and turning brown as the blooms progress into the season. This plant typically flowers between June-October. This is different from a similar species, the brownie thistle (*Cirsium quercetorum*) by noting the egg-shaped bracts that are curved beneath the flower head.

This plant can be found in mesic serpentine grassland habitats, where it is restricted to moist clay openings ranging in elevation from 90-900 meters (USFWS, 2009).

Marin dwarf flax, *Hesperolinon congestum* (Federally threatened, state threatened)
This plant is a federally and state species listed as threatened by the U.S. Fish and Wildlife Service in February of 1995, and California Department of Fish and Game, in June of 1992. The California Native Plant Society lists this plant as rare under status 1B (rare or endangered throughout its range). This plant was in the Final Recovery Plan for Serpentine Soils of San Francisco Bay Area, finalized in September of 1998; with a 5-Year Review just recently started in March of 2009 (FWS, 2009).

This plant is an annual herbaceous rare plant that is endemic to serpentine grasslands where it thrives on bare soil. The stems are slender and grow between 4-16 inches, while the leaves are linear. White to pink, 5-petal flower blooms are noticeable in clusters between May to July. A distinguishable feature from the California dwarf flax found within this region are the deep pink to purple anthers; whereas *H. californicum* has white to rose anthers. This plant should also not be confused with small flower dwarf flax, or the slender dwarf flax also found in the same geographic region. The Marin dwarf flax may be associated with the fountain thistle habitat and the Bay checkerspot butterfly. The elevation range for the Marin dwarf flax is 100-1,200 feet in elevation (FWS, 2009). Currently this plant is only found in four different locations within San Mateo County; though it was historically recorded in Santa Clara County as well (FWS, 1998). Marin dwarf flax thrives on bare mineral (serpentine) soil.

Crystal Springs lessingia (*Lessignia arachnoidea)* CNPS Rare plant 1B.2
This plant is a serpentine grassland annual herb that is endemic to California where it is found on serpentine soils. The stems are erect; leaves are basal withering by flowering. Its elevation range is 60-200 meters. This plant has a pink bloom occurring between July and October. Mapping of this plant occurred in September of 2010 for this project site and it occurs in numerous scattered locations throughout the Fountain Thistle and Boat Ramp Wetland Sites.

San Francisco garter snake *Thamnophis sirtalis tetrataenia* (Federal Threatened, State Endangered, State Fully Protected)
Breeding habitat for the San Francisco garter snake includes "grassy uplands and shallow marshlands with adequate emergent vegetation, and the presence of both Pacific tree frog (*Pseudacris regilla*) and California red-legged frog breeding populations" (USFWS 2006; McGinnis, 1987). A grassland-shrub matrix with an average of one shrub per 20-30 square meters is thought to provide cover from predators as well as open areas for thermoregulation (Barry, 1994). Understory (bunchgrasses or litter) height of at least 20 cm may be a requirement for cover as well (Barry, 1994). Management techniques to maintain open areas may include light grazing or prescribed fire.

Burrows of rodents and other small mammals are used as hibernacula (Larsen 1994) and also provide cover at other times of the year (USFWS, 2006). Burrowing mammals also play a role in maintenance of open grassland habitat by moving nitrogen-poor subsoils to the surface, thus encouraging patches of early successional habitat (Stromberg and Griffin, 1996).

Aquatic habitats supporting San Francisco garter snakes typically include areas of emergent vegetation such as cattails (*Typha* spp.), spike rush (*Eleocharis* spp.), and water plantain (*Alisma* spp.); where emergent vegetation is not present, bordering willows (*Salix* spp). may serve as cover (Larsen, 1994; Barry, 1994). Areas of open water may also be important to sustain the tadpole prey base (USFWS, 2006). Studies elsewhere have shown that excessive woody canopy shading of ponds can reduce food availability for tadpoles and eventually lead to local extirpation of some anuran species (Werner and Glennemeier, 1999).

Shallow wetland margins are thought to be an essential habitat component, because San Francisco garter snakes are more efficient at capturing prey in water less than 5 cm deep (Larsen, 1994). Shallow wetland margins also have a greater frequency of suitable basking locations for snakes (Freel and Giorni, 1994).

Removal of non-native trees and establishment of additional wetland will both enlarge and improve the quality of onsite habitat for this species by providing greater structural habitat diversity, decreasing shade, and increasing the prey base.

California red-legged frog *Rana draytonii* (Federal Threatened)
The California red-legged frog is known to occur at a number of localities throughout the Peninsula holdings, including in marshes fringing the shoreline of Lower Crystal Springs Reservoir (ESA, 2009; Swaim Biological, 2008) Proposed wetland and grassland creation will expand available breeding, foraging and dispersal habitat for this species.

California red-legged frogs breed throughout the rainy season (November to April), with the exact timing varying depending on location and elevation (Storer, 1925). Most eggs are reportedly deposited in March; at Homestead Pond, egg masses have been observed on February 19 and March 13 (Swaim, 2008). Eggs are deposited on the surface of the water but attached to emergent vegetation (Hayes and Miyamoto, 1984). The eggs hatch in 6 to 22 days, and the tadpole stage is relatively long at 11 to 20 weeks (Jennings, 1988; Bobzien et al, 2000; Storer, 1925; Wright and Wright, 1949). Even longer intervals in the tadpole stage have been reported, including overwintering tadpoles noted in the East Bay Area (Bobzien et al., 2000).

California red-legged frogs utilize a variety of habitat types at relatively low elevations (usually below 1,000 meters). Breeding may occur in "streams, deep pools, backwaters within streams and creeks, ponds, marshes, sag ponds, dune ponds, and lagoons" (USFWS, 2002). In streams, deeper areas with slow flow and emergent vegetation may be preferred; however streams are subject to variable flow in the spring, and storm flows may pose some risk to eggs or recently hatched tadpoles (USFWS, 2002). During the day, frogs utilizing streams in Marin County tended to be in or near pools more than 0.5 m deep and with root wads, logjams, or overhanging banks; or on the banks up to 2 m from the water, and under dense vegetation (Fellers and Kleeman, 2007). Ponds, both natural and man-made, are also used for breeding. Frogs were observed under deep water, on banks, or in seasonal wetlands under dense vegetation (Fellers and Kleeman, 2007). Jennings and Hayes (1994) noted the importance of shrubby riparian

vegetation, such as arroyo willow (*Salix lasiolepis*) thickets, as well as cattail (*Typha* sp.) and bulrush (*Scirpus* sp.).

Movement through upland habitat is fairly common, and may extend for distances up to at least 1.6 km (1 mile). Fellers and Kleeman (2007) found that in Marin County, some individual frogs remained at or near aquatic breeding sites all year, but that 66 percent of females and 25 percent of males moved through upland habitat. The greatest straight-line distance moved over a season was 1.4 km. Short movements were noted throughout the year, but movements of more than 30 m were often associated with winter rainfall. When longer movements did occur in the dry season, they usually were prompted by the seasonal drying of a water body. Long-distance movements through open grasslands were common, although multi-night movements tended to follow riparian corridors.

The California red-legged frog has suffered from "elimination or degradation of habitat from land development and land use activities and habitat invasion by non-native aquatic species" (USFWS, 2002). Specific threats in the Bay Area include habitat loss or fragmentation, predation by introduced bullfrogs, alterations of flow regime or hydrology, mortality resulting from automobile traffic in areas where roads cross dispersal corridors, and spread of chytrid fungus.

Expansion of oak woodland, riparian, seasonal wetland and grassland habitats will offer additional foraging areas for this species. Removal of non-native trees will reduce partial barriers to distribution by providing new herbaceous cover in areas presently almost barren at ground level.

5.5 Special Status Species

Although not specifically targeted for this project site, two state special concern species, the western pond turtle and San Francisco dusky-footed woodrat, are also known to occur within or near the site.

Bay checkerspot butterfly *Euphydryas editha bayensis* (Federal Threatened)
The Bay checkerspot is associated with serpentine grasslands, and with three species of host plants which occur in that habitat. Dwarf plantain (*Plantago erecta*), the primary host plant, has been reported from the Boat Ramp site (ESA, 2009). The secondary host plants, purple owl's-clover (*Castilleja densiflora*) and exserted paintbrush (*Castilleja exserta*), have not been noted onsite to date. Planting of host and nectar species may help to make the site suitable for potential colonization. The Bay checkerspot butterfly historically was present on Buri Buri and Pulgas Ridges; the nearest recently extent populations are several miles to the south in the Edgewood Preserve. This population reportedly numbered as many as 100,000 individuals in 1981, but was reduced to fewer than 500 in 1987 and was extirpated by approximately 2003 (Arnold et al, 1994). A reintroduction took place in 2007 (Friends of Edgewood Natural Preserve, 2008). Edgewood Park and the northern part of Homestead Pond are within the area designated as Critical Habitat (USFWS, 2008).

USFWS (2008) summarized key habitat elements for the bay checkerspot: 1) annual or perennial grasslands with little or no overstory and a grade of at least seven degrees; 2) presence of the primary host plant, dwarf plantain, and at least one of the secondary host plants, purple owl's-clover or exserted paintbrush; 3) presence of adult nectar sources, such as desert parsley (*Lomatium* sp.), California goldfields (*Lasthenia californica*), tidy-tips (*Layia platyglossa*), sea

muilla (*Muilla maritima*), scythleaf onion (*Allium falcifolium*), false babystars (*Linanthus androsaceus*), and intermediate fiddleneck (*Amsinkia intermedia*); 4) soils derived from serpentine ultramafic rock; and 5) the presence of stable holes and cracks in the soil and surface rock outcrops to provide shelter during larval diapause.

Serpentine grasslands typically have low levels of nitrogen. Excessive nutrient enrichment encourages encroachment by exotic and invasive plants which out-compete native species including those essential for the bay checkerpot (USFWS 2008).

Planting of secondary host and nectar species could provide a potential satellite habitat site to accept dispersal in high reproduction years.

San Francisco dusky-footed woodrat *Neotoma fuscipes annectans* (State Special Concern)
This subspecies occurs around the southern part of the San Francisco Bay area. Large permanent stick nests are built, often within riparian forest, scrub, or oak woodland. Related and more widespread subspecies also utilize a variety of upland shrub and woodland community types.

Woodrat nests have been observed at numerous locations within the Peninsula holdings, including immediately within the Boat Ramp wetland enhancement area. A dead and apparently predated individual of this species was observed near the edge of the fountain thistle stand during a June 2010 site visit (W&K pers. obs.).

Western pond turtle *Actinimys marmorata* (State Special Concern)
Western pond turtles are known to occur along the margins of Upper Crystal Springs Reservoir, and are probably present near the site.

This species inhabits permanent and semi-permanent aquatic habitats with slow or no flow. Highest densities are reported to occur where basking sites are common (Jennings and Hayes, 1994), although to some extent this may be due to a higher probability of observation of basking turtles. Eggs are deposited in relatively dry and open upland sites, sometimes on south-facing slopes, and sunlight may be essential to maintain adequate thermal conditions for egg incubation. Nests are generally on slopes of less than 25 degrees (Jennings and Hayes, 1994). Most nesting sites are within 200 meters of a pond, although a few nests have been reported at much greater distances (Storer, 1930). Hatchlings require relatively shallow water with dense emergent or submerged vegetation (Jennings and Hayes, 1994).

Adult turtles are capable of long-distance movements (2 km or more; Jennings and Hayes, 1994) but movements away from ponds are rare except for nesting or when water sources become dry (Rathbun et al, 1992, 1993). Overwintering may occur on land or in the water; in mild coastal locations such as the project area, occasional winter activity may occur (Rathbun et al. 1993).

Removal of non-native trees will open up travel corridors to additional potential nesting sites and facilitate dispersal. Enlargement of wetlands and any increase in hydroperiod will improve the quality of aquatic habitat.

5.6 Target Communities

Because of the habitat requirements of the species discussed above, and existing habitat features at the site the following plant communities and habitat types are targeted for establishment and enhancement.

Plant communities present at the Boat Ramp sites are shown in Figure 7. These community types are summarized below along with brief comments on their relative quality and importance for sensitive species. Community classification follows Holland (1986). The diverse array of woodland, grassland, scrub, and wetland communities found within the site is capable of supporting a species-rich wildlife assemblage; for example, some of the sensitive species known to occur on the site utilize more than one community type, and each uses a different combination of habitats. However, the relatively degraded quality of some habitats due to fire suppression, fragmentation by roads, hydrological alteration (as a result of road construction and increased evapotranspiration), invasion of non-native species, and other factors currently limits the value of the site. Planned habitat establishment and enhancement will increase both the area and quality of habitat for sensitive species.

5.6.1 Serpentine Grasslands

Extensive serpentine grasslands are present on gentle slopes within the Boat Ramp Fountain Thistle site, and serpentine grassland habitat will be re-established in the pine removal area. This will remove an area of non-native habitat currently dividing two areas of serpentine grassland. With management to maintain native grassland structure, this area can provide important basking and foraging habitat for San Francisco garter snake and foraging and dispersal habitat for California red-legged frog. Planting of host and nectar species will encourage expansion of potential Bay checkerspot butterfly habitat. Seepage indicator species such as *Deschampsia caespitosa* var. *caespitosa* will be included in the planting mix, to identify suitable locations for subsequent planting of fountain thistle.

5.6.2 Wetlands

Seasonal wetlands provide important habitat for San Francisco garter snake, California red-legged frog, and western pond turtle. Very little wetland habitat is present on the site at present; the project proposes to increase the size of a small vernal marsh through excavation and raising of a culvert and gravel road.

Proposed wetland establishment is expected to result in a net gain of jurisdictional wetland area, and habitat for sensitive species. Proposed mitigation activities will provide foraging habitat for California red-legged frogs and San Francisco garter snakes.

5.7 Design Schedule

The anticipated design schedule is as follows:

January 15, 2010:	Preliminary Draft Mitigation and Monitoring Plan completed.
September 27, 2010:	Final Draft Mitigation and Monitoring Plan completed
August 31, 2010:	65% drawings and specifications.
October 29, 2010:	95% drawings and specifications
February 11, 2011:	Final drawings and specifications.

Construction is expected to begin in the late summer of 2011.

6.0 IMPLEMENTATION

6.1 Site Preparation

6.1.1 Overview

Target establishment and enhancement acreages are identified below and in Table 3 for each habitat type (Figure 10).

Non-native tree cover has created dense shade and displaced native serpentine bunchgrass grasslands on several acres of the Boat Ramp Fountain Thistle site. The pine stand is contiguous with and immediately upslope of a large concentration of fountain thistle. The Crystal Springs lessingia can be found throughout the pine removal areas, with young pines encroaching into rare, threatened and endangered species habitat. And though less abundant, few individuals of the lessingia plant occur within the limits of disturbance associated with the wetland enhancement and establishment area.

Monterey pine within the site will be cut and removed to halt encroachment and enhance habitat (Figure 10, Appendix A). Pine removal is broken into three tree removal zone types: Pulley System Zone- will be used in the most sensitive zone; Bucket Truck/Crane System Zone- will be used in the moderate sensitivity zone; and Conventional System Zone- is the least sensitive and will be utilized for the majority of tree removal where there are no known special status plant populations. These zones were delineated based on the spatial extent of rare, threatened and endangered plants, and the capability of tree removal equipment and methods. Once trees are removed from the site, pine needle duff and debris will be removed and scraped down to bare substrate (Weiss & Neiderer, 2009). In the most sensitive tree removal zone the pine needle duff will be removed cautiously by hand. Serpentine plants tend to grow on bare ground, therefore scraping before seeding is a preferred habitat management technique for site preparation in the serpentine bunchgrass enhancement areas, based on the Presidio Clarkia federally endangered serpentine endemic plant restoration.

A preconstruction survey will occur prior to tree removal for ground-truthing, flagging and fencing rare plant locations. Pines in the center and eastern portion of the stand (closer to Skyline Boulevard) will be removed using conventional methods, following the survey to verify that no sensitive species are at risk.

The moderate sensitivity zone will make use of a crane or other suitable method to avoid or minimize ground damage and risk to sensitive species. Stumps will be cut close to the ground surface and left in place to avoid risk of altering groundwater flow. There are two moderate sensitivity zones within the Fountain Thistle project area. One moderate zone is located in the most northern part of the boundary and the second is located in the southern portion of this project area, below the conventional zone, yet above the most sensitive zone. Both of these areas where defined based on the limit of lessingia populations mapped in September, 2010, and tree removal equipment access.

The lower portion of the pine stand, which is intermingled with fountain thistle and lessingia, is the most sensitive zone and will require specialized methods for tree removal. The proposed design will make use of a pulley and winch system to lift the trees out to avoid and/or minimize

ground damage and risk to sensitive species. Stumps will be cut close to the ground surface and left in place to avoid risk of altering groundwater flow. A few individuals of coyote bush or poison oak may stay in place in the most sensitive zone if the surveyor or SFPUC representative determines that sensitive species are intermingled with the undesirable plant.

Small areas of scrub habitat will also be removed at the Boat Ramp Wetland Enhancement site, which is approximately 450 feet from the Fountain Thistle site. An existing wetland basin will be enlarged by excavation. Spoil material will be used to raise the road surface, and the existing culvert will be raised.

A grading plan cross section is shown on Figures 9. Acreages of enhanced and re-established plant communities are shown below in Table 3.

The project would include the specific implementing components further described below.

Table 3. Boat Ramp Sites, Existing and Post-Project Habitat

	Pre-project	Pre-project	Post-project	Post-project
	Area (sf)	Area (acres)	Area (sf)	Area (acres)
Coast Live Oak	1861	0.04	1861	0.04
Non-Native Stand	118,346	2.72	0	0
Northern Coyote Brush Scrub	63,197	1.45	9,826	0.226
Ruderal	3,340	0.012	1,881	0.043
Seasonal Wetland Enhancement	2,178	0.05	2,178	0.05
Seasonal Wetland Established	0	0	893	0.17
Serpentine Bunchgrass	72,276	1.66	260,924	5.28
Serpentine Bunchgrass Re-established (fountain thistle habitat)	0	0	30,928	0.71
Unclassified Invasive Species Management Area	959,414	22.03	959,414	22.03
Willow Riparian Forest and Scrub	1,385	0.03	1,385	0.032
TOTAL	**1,221,997**	**27.99**	**1,238,362**	**28.58**

6.1.2 Native Species Protections and Exclusions

To minimize effects on desirable habitats and species, avoidance measures will be implemented.

Disturbance limits will be clearly defined and identified to prevent damage to existing serpentine grasslands and, especially, fountain thistle, lessingia or other sensitive species. Exclusion fencing will protect good quality habitat including existing grasslands, protected species and wetlands. Access routes for equipment will be limited to the existing access road, and via a staging area at the upper end of the pine stand and a clearly defined and fenced access road leading from the

staging area into the pine stand. A few spur roads may be used in the conventional tree removal zone to provide access to the more sensitive fountain thistle areas.

The area of excavation (less than 1.0 acres) is expected to be limited to the wetland establishment area and the existing road. Excavated material will be re-used on site to raise the road bed. In the lower part of the Monterey pine stand or wherever sensitive species are identified by pre-construction surveys, a crane or other suitable method will be used to remove pines in a way that avoids or minimizes ground disturbance. The total area of disturbance is expected to be approximately 4.5 acres, including tree and shrub removal, staging, disturbance associated with wetland excavation, and activities associated with establishment of wetland and grassland habitat.

Native trees, especially the few oaks present on site, will be protected as much as possible during clearing and excavation. Impacts to native serpentine grassland will be minimized, although some very limited disturbance is likely during pine removal. Temporary impacts will be mitigated through restoration activities including revegetation with native species, and habitat enhancement for listed plants. The temporary loss of habitat will be compensated by reducing the amount of habitat credit available to compensate other SFPUC projects.

The boat ramp site has several special status plants; therefore tree removal will need to take in account avoidance measures to ensure that these plant populations are not adversely affected as a result of restoration activities. The main plants of concern are those on Figure 7b, Rare Plants, and include fountain thistle, Crystal Springs lessingia, and Marin dwarf flax.

The fountain thistle is limited to the southern boundary of the site. Tree removal design efforts are tailored to avoid and minimize impacts to this sensitive endangered plant. The southern portion of the Fountain Thistle site is where the largest occurrence of this plant exists; two smaller subpopulations occur on the east side of Skyline Boulevard in the invasive species management area of the project boundary.

The Crystal Springs lessingia is peppered throughout the site, but most populations were mapped as two patches in September 2010. These populations can be describes as occurring in the east side of the fountain thistle area. The second largest patch coincides with the fountain thistle polygon; the northern limit of the fountain thistle polygon is the southern limit of the lessingia polygon. Another small patch of lessingia occurs on the northwest side of the fountain thistle project boundary. One small patch occurs on the eastern side of the wetland enhancement area.

The Marin dwarf flax has been mapped at two points on the southern limit of the fountain thistle polygon and they are beyond the project boundary and limits of disturbance.

All tree removal activities, road access, and stockpile locations will take into account these rare, threatened and endangered plants (Table 4). However, some of these plants are annuals and changes or annual variability may occur in their distribution from year to year. The most up to date mapping will be used to the extent possible, but a preconstruction survey would also occur in order to flag, and fence all rare plants. In addition, a biological monitor would be present during construction to ensure that sensitive plants and wildlife avoidance is implemented to the greatest extent possible. Where avoidance is not possible, restoration activities would mitigate any harm to individual plants during project implementation including tree removal and habitat enhancement, due to the overall net gain in viable habitat for these species after construction has been completed.

Table 4: Tree Removal Zones and Potential Impacts to Sensitive Species

Tree Removal Zones Impacts to Sensitive Species	Square Feet	Acres
Tree Removal Zone - Conventional 3.12 ac		
Crystal Springs Lessingia	598.91	0.014
Fountain Thistle	0.00	0.00
Tree Removal Zone - Bucket Truck/Crane 1.99 ac		
Crystal Springs Lessingia	26880.98	0.62
Fountain Thistle	0.00	0.00
Tree Removal Zone - Pulley System 0.88 ac		
Crystal Springs Lessingia	4,625.06	0.11
Fountain Thistle	24,343.26	0.56

Additional avoidance and minimization measures for the fountain thistle, Crystal Springs lessingia and other rare, threatened or endangered species on the Boat Ramp Project Site include:

- Limits of disturbance will be the smallest practical work footprint
- Where protection is not possible, it may be possible for the contractor to schedule work in sensitive areas after the plants have set seed (after October).
    - SFPUC staff or representative should collect rare plant seed and will stockpile organic material and top four inches of topsoil with the appropriate permit conditions.
    - Once construction is complete the stockpile will be placed in the disturbed areas as a top dressing.
    - Or, before winter rains begin, SFPUC will arrange to harvest lessingia material prior to the start of construction and replace the material once restoration activities are complete.
- Contractors will be trained to identify the rare plants on site (fountain thistle, Crystal Springs lessignia and Marin dwarf flax), and to be aware of environmental laws, guidelines, and policies to ensure adequate knowledge and avoidance of desired features
- Workers assisting with vegetation clearing in the fountain thistle and rare plant area will be taught how to best avoid these plants
- Exclusionary fencing and/or flagging will be erected to alert crews to the presence of sensitive habitat and rare plant populations to serve as a protection feature to alert crews to the presence of sensitive habitats and to serve as protection
- Require crews to stay within designated work areas
- Grading and ground disturbance work will be avoided from the first significant rain to May 1 for California red-legged frog protection
- Construction equipment will be cleaned before entering sensitive habitats and after invasive species removal work is completed, to reduce spread of undesired and potentially invasive plants
- If grazing is included as part of the initial invasive species management plan or if grazing is implemented as part of the long-term or adaptive management plan goats will be excluded from sensitive habitat areas with fencing

- Woodrat nest will be avoided or relocated (see mitigation measures below)

San Francisco dusky-footed woodrat *(Neotoma fuscipes annectans) Mitigation Measures*
The species will be removed from the areas of construction using a passive eviction approach.

- All known active nests that are not within the active area of construction should have 2' buffer with exclusion fencing.
- A biological monitor should do a preconstruction survey of the project site to determine if the woodrat is present or if their nest or den is located within the project site.
- If the woodrat is found or evidence of their nests are observed, then the biological monitor should relocate the animal and nest accordingly:
    - Any nest that is known in the areas where there will be grading or tree removal, or any nest found during implementation of the project should be dismantled before the clearance of vegetation or ground disturbance. This will allow the animal to escape and gain new territories prior to the breeding season. This mitigation action should only be allowed in the non breeding period.
    - Appropriate timing is important to consider because disturbing the den or dismantling the nest and encouraging the woodrats to seek refuge away from the project site in the wrong time of year could influence the separation of female's from their young.
    - When nests are dismantled this should be done by hand so that the animal can escape into adjacent habitat, via their known pathway. If young are present when a woodrat is identified on the site the nest should be avoided for a few weeks to allow the animals to grow large enough so when the nest is dismantled the young will have an increased chance of survival (Loudermilk, 2008).
    - Once the woodrat has fled elsewhere, then the sticks from the nest should be picked up and moved to a nearby location with optimal habitat and structural cover including logs and brush.
    - The biological monitor should be familiar with public safety and health hazards associated with the woodrat and their nests, and proper guidelines for protection.

A construction monitor shall be on site during excavation, grading and tree removal, and any other activities which include use of equipment or ground disturbance. The monitor shall be experienced with and have appropriate permits to handle the protected species known to occur or potentially present on site. The monitor will check under and around equipment before it is moved after a period of inactivity, and will visually clear each area to be disturbed immediately before work begins. If a protected or sensitive species is located during grading or other ground disturbing activity, construction activity shall cease while the monitor determines an appropriate course of action. When practicable, an animal will be allowed to move out of the construction area on its own. In some circumstances the monitor may elect to move the animal a short distance within the site and into appropriate habitat with adequate cover from predators. (Note SFGW will not be handled or harassed due to fully protected status)

6.1.3 Grading
Excavation and grading is proposed only at the Boat Ramp Wetland Establishment site, to enlarge an existing seasonal wetland. Grading will also be necessary to spread and compact spoil material used to raise the road bed. Equipment will enter from Skyline Boulevard via the existing locked gate and gravel road, and a staging area will be constructed next to the road below the excavation area, on an area of disturbed annual grassland.

Grading of the new wetland basin will include gentle slopes (2:1) to the extent practical, to mimic the seasonal wetland reference site, with a slightly steeper slope on one side.

No grading is proposed at the Fountain Thistle site.

A grading plan with cross sections of the created wetland areas are shown in Figure 9.

6.1.4 Tree removal

Approximately 213 trees will be removed from the fountain thistle project area. Most of the trees to be removed are not immediately adjacent to the fountain thistle. There are approximately 35 trees to be removed within the fountain thistle area, and 178 trees outside of the most sensitive habitat area. By removing these undesirable trees, the fountain thistle and rare plant populations should have an increased area with necessary habitat requirements to allow for expansion of the desirable plant communities.

This plan has been written to avoid or minimize impacts to the fountain thistle. For Monterey pine removal, a new gate and staging area will be placed along the existing perimeter fence in the uppermost part of the pine stand, close to Skyline Boulevard. Three stages of tree removal are proposed:

- Zone 1- the Pulley system (0.88) is considered to be high sensitivity due to the abundance of thistle making these trees the most difficult to be removed including a few young pines in the heart of the fountain thistle stand beyond the reach of conventional equipment. For these trees, a taut cable may be run through the drip line of the trees with the cable used to shuttle branches and trunk pieces in a sling back to a work truck. The down-slope support of this cable may be secured from a pine tree (to be removed in the future). It appears that many of the trouble trees could be removed using this method as long as the tree person could safely walk into the tree base to climb the tree with a chain saw. Although some thistle areas are very dense, with an on-site, daily plant monitor, it appears that a qualified arborist could be trusted to gain foot access into the pine trees for removal (again, under the oversight of one plant monitor per tree removal crew).
- Zone 2- Bucket truck/crane system (1.99 acres) is considered to be of moderate sensitivity. In this zone a crane, bucket or other suitable equipment to lift trees just within the edges of the fountain thistle stand, but which can be approached by vehicles with low-impact tires. Access is limited for vehicles as this zone contains large patches of lessingia and possibly a few scattered fountain thistles.
- Zone three –the conventional system (3.12 acres) is considered the low sensitivity area, well away from any fountain thistle or other rare plants, where conventional logging methods may be safely used. Zone 3 includes most of the higher elevations in the western portion of the tree removal area (Figure 10).

6.1.5 Soil Disposal

Soil excavated to expand the wetland will be used to raise the existing access road. Material will be graded to avoid sudden elevation changes or steep slopes, as nearly as practical. The road is expected to be only slightly higher than at present, thus it will not be an erosion or slope failure risk, and it will not create a barrier to wildlife movement. Reuse of the material onsite will minimize construction time and expense, and will eliminate or reduce the need for truck trips to haul material. Once the road is graded, any bordering bare soil will be planted with an erosion control mix.

Although local grading may be necessary in selected locations to repair damage associated with tree removal or construction staging, no other soil disposal is anticipated.

6.1 6 Soil Treatment

Soil fertility samples were collected at three locations at the Boat Ramp Fountain Thistle site and at one location at the Boat Ramp Wetland Establishment site on November 10th, 2009. Soil sampling at shallow depths was conducted by installing 2-inch-diameter hand augured boreholes to the maximum depth possible (until refusal at bedrock or gravels). Soil samples were collected and logged to document observed soil conditions at the site. Surface and subsurface soil samples were collected, when feasible, for physical and chemical testing. Samples were submitted to a laboratory for chemical testing. All equipment was walked to the sites, and the support vehicle (pick-up truck) remained on an existing service road nearby to avoid unnecessary compaction of surrounding soils and vegetation. Two workers were present at the site during sampling.

Soil sample locations are shown in Figure 6. Soil sample locations were selected at the fountain thistle site to be representative areas yet where disturbance to existing plants would not occur. Soil sample location was selected at the wetland establishment site to be representative of the future proposed surface after grading occurs to create a wetland basin. A single soil pit SP-4 was installed at the wetland establishment site to a total depth of 3.0 feet bgs. A sample was collected from the total depth at soil pit SP-4 (from 30 to 36 inches) to characterize the future wetland surface from a soil fertility standpoint. Soils at this location were clay loam at the surface, clay and clay loam in the subsurface, with gravelly clay loam beginning at 2.75 feet bgs. Three soil pits (SP-5a, SP-5b, and SP-5c) were installed within the existing fountain thistle habitat area. Due to shallow soils and dense semi-impervious layer beginning from 6 to 12 inches below ground surface (bgs), soil pit SP-5a was installed to a total depth of 12-inches bgs; and soil pits SP-5b and SP-5c were installed to a total depth of 0.5 feet bgs. Surface soil subsamples were collected at soil pits from 0 to 6-inches depth and composited at a 3:1 ratio. A subsurface sample was collected from the total depth of the soil auger hole (1.0 feet bgs) at test pit SP-5a. The soils are characterized as loam to clay loam. Sub-surface hydrologic conditions are the main interest for this site but due to the season there were no signs of groundwater and all soil auger holes appeared dry. Boring logs for soil pits and are provided in Appendix C. Soil fertility analytical results are summarized below in Table 4 and laboratory analytical reports are provided in Appendix C.

Table 5. Summary of Soil Fertility Analysis

Location	Depth (inches)	Sample	OM	Macronutrients-Primary (N/P1/P/K[1])	Macronutrients-Secondary (Ca/Mg/S)[2]	Micro-nutrients (Zn/Mn/Fe/Cu/B)[3]
SP-5	0-6	SP-5(0)	VH	L/L/M/L	VL/VH/VL	L/M/VH/L/L
SP-5	6-12	SP-5(6)	H	L/VL/M/L	VL/VH/L	VL/M/H/L/VL
SP-4	30-36	SP-4(30)	H	L/L*/M/L	VL/VH/L	VL/L/H/H/VL

Location	Depth (inches)	Sample	pH	CEC (meq/100g)	CEC % Saturation (K/Mg/Ca/H/Na)	Excess Lime Rating	Soluble Salts (mmhos/cm)
SP-5	0-6	SP-5(0)	6.0	20.7	1.0/73.3/16.3/7.5/1.9	L	L
SP-5	6-12	SP-5(6)	7.2	22.2	0.9/86.3/10.5/0.0/2.3	L	VL
SP-4	30-36	SP-4(30)	8.0	29.9	1.1/81.2/17.0/0.0/0.7	L	VL

Code Rating: Very Low (VL), Low (L), Medium (M), High (H), Very High (VH)
OM = organic matter (in percent and rating)

CEC = Cation Exchange Capacity
*Phosphorus measurement using Weak Bray (P1) method is unreliable at Medium or High excess lime or pH 7.5
1. Primary Macronutrients are Nitrogen (N), Phosphorus using the Weak Bray test (P1), and Phosphorus using the Olson Method that measures $NaHCO_3$-P (P)
2. Secondary Macronutrients are Calcium (Ca), Magnesium (Mg), and Sulfur (S)
3. Micronutrients are zinc (Zn), Manganese (Mn), Iron (Fe), Cooper (Cu), Boron (B)

Results:
At the boat ramp sites, the surface and subsurface samples had the following general notable results:

- Organic matter: high to very high levels;
- Primary macronutrients: low levels of nitrogen and potassium, low to medium levels of phosphorus;
- Secondary macronutrients: very low levels of calcium; very high levels of magnesium; low to very low levels of sulfur;
- Micronutrients: very low to low levels of zinc and boron, low to medium levels of manganese, high to very high levels of iron, low levels of copper except at wetland establishment subsurface where copper levels were high;
- Cation Exchange Capacity (CEC) ranging from 22.2 to 29.9 meq/100g (up to 86% saturation of magnesium and up to 17% saturation from calcium);
- pH range of 6.0 to 8.0, with pH increasing with depth.

Recommendations:

- Soil fertility guidelines for use of these soils to support wetland plants (wetland creation) or grassland (for fountain thistle site), recommends amending the soil with up to 250 pounds per acre gypsum to raise the calcium level from very low, and to provide an improved balance with magnesium (very high rating). The calcium to magnesium ratio is so drastic because the soils are derived from serpentine formation. If serpentine tolerant plantings are used, this soil amendment process is not likely necessary.
- The fertility guidelines also recommend adding a nitrogen/phosphorus/potassium fertilizer, but this is not recommended for this site as it could stimulate invasive species as well. The high organic content of the soil will provide some nutrients for proposed native plantings. Adaptive management should be used to determine post-planting if particular nutrients are inhibiting plant growth, and will be evaluated during the annual monitoring.
- Conclusion: Although the lab recommends applying soil amendments, the application of amendments may affect the pH of the water, cause eutriphocation, and nutrients could move offsite due to water movement.

6.1.7 Water Supply and Irrigation

Irrigation will be needed only if oaks or riparian vegetation adjacent to the access road are damaged and must be replaced. Thus, it is anticipated that irrigation may not be necessary at this site.

If needed, water may be sourced from surface and/or groundwater supplies that are available (and permitted) to the project Owner either at the project site or transported to the project site.

Soil should be moistened before plant installation begins, either from rainfall or human procedures. Plantings of tree, shrub (if any), and perennial species should receive a deep watering at time of installation (approximately 10 gallons per individual plant with root ball).

Plantings should be irrigated for 24 hours after initial planting if natural rainfall is not imminent. Areas seeded with seed mixes should receive a gentle watering at time of installation. Depending on whether installation occurs in dry season or wet season, supplemental watering once every approximately 10 to 15 days may be necessary in order to promote deep root growth and target species establishment. Irrigation should be continued at least until the onset of the cool weather/wet season and/or a prolonged period of early rain in the fall. Irrigation as a method of ongoing maintenance during the monitoring period is further discussed in Section 6.4 of this report.

6.1.8 Invasive Plant Control and Undesirable Native Species Plant Control

Re-establishing native grass seed in the serpentine grassland and invasive management area is a goal for this plan. Weed competition is a major factor to consider throughout the mitigation timeframe and extending into long-term management timeframe. In order to allow the low vigor, slow germinating native seeds to grow, intensive invasive species management and weed control are required to compete against the vigorous, quickly germinating, high density non-native annuals. The main factors to establishing the native grasses are to ensure adequate sunlight, soil moisture, and nutrients are available for the seeds to mature some of which require two to three years to become vigorous individuals (Anderson, 2010).

A variety of techniques have been studied in central California grasslands and the literature documents that a combination of techniques will yield the most successful results. The combined methods include herbicides (pre and post), and mowing. Because of regulatory and other constraints, some methods may not be available for use at the Boat Ramp sites.

6.1.8.1 Target Invasive Plant Species

Target species for non-aquatic, upland habitats are species with high or moderate impacts rankings in the California Invasive Plant Council's (Cal-IPC) Central West list (excluding those listed as exempt below), as well as those species that are rated as high or moderate by the Cal-IPC list in the future (but excluding species that are considered to appear rarely in monotypic stands or to have low/minor impacts in our region).

Target invasive species for wetland habitats, riparian habitats, and other aquatic habitats regulated by USACE, RWQCB, and CDFG are the same as for non-aquatic/upland habitats, with the addition of the species ranked as Tier 1 and Tier 2 in the Water Board's Fact Sheet for Wetland Projects http://www.waterboards.ca.gov/sanfranciscobay/certs.shtml.

Scientific Name	Common Name	Cal-IPC rating	Considered a Target Invasive by SFPUC?	Rationale for not being considered exempt from the list of target invasives in non-wetland areas
Brassica nigra	black mustard	Moderate	N	Widespread. Primarily a weed of disturbed sites, but can be locally a more significant problem in wildlands.
Bromus diandrus	ripgut brome	Moderate	N	Monotypic stands uncommon.
Cynosurus echinatus	hedgehog dogtailgrass	Moderate	N	Impacts vary regionally, but typically not in monotypic stands.
Erechtites glomerata, E. minima	Australian fireweed, Australian burnweed	Moderate	N	Impacts low overall. May vary locally.

Scientific Name	Common Name	Cal-IPC rating	Considered a Target Invasive by SFPUC?	Rationale for not being considered exempt from the list of target invasives in non-wetland areas
Hordeum marinum, H. murinum	Mediterranean barley, hare barley, wall barley	Moderate	N	Generally do not form dominant stands.
Hypericum perforatum	common St. John's wort, klamathweed	Moderate	N	Abiotic impacts low.
Hypochaeris radicata	rough catsear, hairy dandelion	Moderate	N	Impacts appear to be minor.
Lolium multiflorum	Italian ryegrass	Moderate	N	Impacts vary with region.
Rumex acetosella	red sorrel, sheep sorrel	Moderate	N	Widespread. Impacts vary locally.
Trifolium hirtum	rose clover	Moderate	N	Impacts relatively minor in most areas.
Vulpia myuros	rattail fescue	Moderate	N	Rarely forms monotypic stands

Invasive or non-native plants currently present on the site that will need to be removed include French broom (*Genista monspessulana*), pampas grass (*Cortaderia selloana* and *C. jubata*), slender oats (*Avena barbata*), periwinkle (*Vinca major*), velvet grass (*Holcus lanatus*) and Harding grass (*Phalaris aquatic) (* ESA, 2009). Additional invasive plants may be identified during site clearing and construction. The following management tools will be adequate to address species that are found during project implementation (see long term management section).

Invasive or non-native plants currently present on the site that will need to be removed Monterey cypress (*Cupressus macrocarpa*), Monterey pine (*Pinus radiata*), pampas grass, French broom (*Genista monspessulana*), fennel (*Foeniculum vulgare)*, Harding grass, cotoneaster *(Cotoneaster franchetti),* yellow star thistle (*Centaurea solstitialis)*, teasel *(Dipsacus* sp), tocalote (*Centaurea melitensis*), wild oats (*Avena fatua*), and poison hemlock (*Conium maculatum*).

6.1.8.2 Undesirable Native Species Plant Control

Undesirable native plant control refers to the species that are native to California, yet are not native in the Peninsula watershed; or are reproducing at alarming rates because historic management techniques no longer occur within the project boundary. These plants are thought to be invading certain ecotypes where they out-compete desirable native plants and their habitat niches including grasslands.

The following plants are native to California, but not to the Upper San Mateo Creek site Monterey cypress (*Cupressus macrocarpa*), Monterey pine (*Pinus radiata*); the following are native, yet need to be managed to promote grassland habitats: coyote brush *(Baccharis pilularis)*, and poison oak (*Toxicodendron diversilobum*). These pioneer trees and shrubs are undesired native plant species, considered to be intruding on native grassland habitats in this region. The following management tools will be adequate to address both non-native and native undesirable species that are found during project implementation (see long term management section). It is likely that at least a few additional invasive species will be identified during pre-construction surveys. A complete table of species to be controlled on site is located in table 6 below.

Table 6. Boat Ramp Invasive& Undesirable Plant Species		
Common Name	***Scientific Name***	**CAL_IPC**
cotoneaster	*Cotoneaster franchetti*	Moderate
coyote brush	*Baccharis pilularis*	-
Fennel	*Foeniculum vulgare*	High
French broom	*Genista monspessulana*	High
Harding grass	*Phalaris aquatica*	Moderate
Monterey cypress	*Cupressus macrocarpa*	-
Monterey pine	*Pinus radiata*	-
pampas grass	*Cortaderia jubata*	High
poison hemlock	*Conium maculatum*	Moderate
poison oak	*Toxicodendron diversilobum*	-
Teasel	*Dipsacus sativus*	Moderate
Tocalote	*Centaurea melitensis*	Moderate
velvetgrass	*Holcus lanatus*	Moderate
yellow star thistle	*Centaurea solstitialis*	High

It is likely that at least a few additional invasive species will be identified during pre-construction surveys. Invasive species are an important issue on the Boat Ramp sites, and invasive removal and management would be the only activity planned at this time for the larger portion of the site above (east of) Skyline Boulevard.

Mechanical removal, including hand pulling and mowing, will be the primary means of removing and controlling invasive vegetation. In addition to mechanical methods, fire should be included as a long-term management technique to ensure success of the stated project goals by mimicking the historical maintenance regime of native grasslands. For best results, a combination of a natural herbicide, mowing, hand pulling, mechanical clearing, fire, tree shelters, and re-seeding will yield the most successful results in the re-vegetation plan and reduction of non-native plants.

Below several strategies are described that could assist to address the issue of invasive species at the project site, both before initial planting as well as during the monitoring phase. In many cases, multiple strategies combined will be most effective in eliminating specific unwanted species from the project site, and in all cases monitoring and adaptive management will be key to long-term success of the restored habitats and elimination of invasive species. Once the native target species are established, it is anticipated that they will out-compete the invasive species. After the general strategies discussion below for invasive control, individual invasive species known to occur at the project site are addressed in the context of which strategy(s) should be considered for feasible elimination of that species. Seasonal control methods and timing may conflict with some species, and care should be taken when evaluating particular methods for more than one species. For example, mowing provide more favorable results for one species if done is the spring versus having little effect on another species if done during the same timeframe. A combination of strategies, in site specific locations, pertaining to individual species

will yield the highest success of controlling invasive and undesirable plants on the site. Appendix H has a table for the proposed invasive species control schedule.

The Boat Ramp site should consider limiting invasive control implementation to using only manual methods within in the fountain thistle and Marin dwarf flax habitat, the wetland area, or where there are known special status plant species. A 100 foot buffer should be outlined for any activities of invasive control beyond manual removal of the invasive species (mowing, herbicide, or grazing). Well timed preparations for growing the grasses should be followed with mowing and follow-up manual pulling of unwanted vegetation which can be achieved with a strong labor force for the duration of the 5 year monitoring timeframe. For the larger 35 acre Invasive Management Site, and throughout the remaining areas of the site if thought appropriate it may be possible to utilize a combination of cutting, mowing, pulling, and stem applied herbicide treatment.

6.1.8.3 Invasive Species and Undesirable Native Species Removal Strategies

Herbicides

To comply with City of San Francisco requirements for City owned property, use of pesticides (including insecticides, herbicides/weed-killers, fungicides, rodenticides) should be employed as a method of last resort for pest removal, and only after exploring all applicable non-chemical options. Only products listed on the San Francisco Reduced-Risk Pesticide List (RRPL) (*http://www.SFEnvironment.org/ipmchecklist*) in table 7 below, may be used on City-owned properties (SF Environment Code, Chapter 3), and must be used in a manner consistent with limitations described on the RRPL and the US EPA label. Herbicides listed on the 2009 RRPL that may have use at the project site for invasive species removal are summarized in the table below (Year 2011 list should be consulted when published prior to project implementation), and precautions for use in California red-legged frog habitat are noted in the "Limitations / Notes" column. One herbicide that is not yet on the list but may be an option for this site on jubata grass is the potential use of impazapyr, which is currently being tested on controlled pilot plots on jubata grass on SFPUC lands as part of their herbicide resistance management program (SFDEP, 2010).

Herbicides have many methods of application, including, wicking. This technique uses herbicide contained in a reservoir and hand held wick applicators, which whips a concentrated solution on the tops of weeds, while leaving the shorter annuals unaltered. Spot application is another technique and can be applied with a backpack sprayer. Basal bark treatments are good for woody invaders such as poison oak, coyote brush, French broom and larger individuals of pampas grass; and stump application has been proven effective for poison oak infestation.
This treatment can be applied any time of year using a sprayer or wiping the basal parts of bush stems. Painting herbicides with a paint brush for sensitive areas has also proven to be effective without adversely affecting adjacent vegetation or sensitive habitats.

Milestone (active ingredient Aminopyralid, triisopropanolamine salt 40.6%) can be used as an herbicide on the Boat Ramp site and can be applied in the fall using spot sray, backpack or stem treatments depending on the target weed and habitat. This herbicide is applied at 4-7 ounces per acre using a treatment to control annual, perennial, and biennial weeds in the uplands, wildlife habitat, and up to the water edge of wetlands, creeks, and ponds. This herbicide has a wide window for applications and can be applied up to the fall. An additional approved herbicide restricted to a subset of San Francisco's "Reduced Risk" Pesticide List:

- Eugenol (clove oil) 21.4%; 2-phenethylpropionate 21.4% (EcoEXEMPT™)
- Triclopyr (Garlon 4)
- Roundup (glyphosate)

If deemed necessary to apply herbicides for site preparation, maintenance, or adaptive management near or around the wetlands and riparian habitats, Aqua master is a nonselective herbicide approved for aquatic applications to control emergent vegetation. Once the active ingredient (glyphosate) makes contact with water, it becomes deactivated; therefore only the vegetation on or above the water is impacted. This herbicide has best results when Activator 90 surfactant, or a similar nonionic surfactant, is added to the mixture. Aquamaster can be applied by spray, cut stump, and with injections. This herbicide is used to control emergent or floating plants, in or along banks, active ingredient glyphosate has been manufactured to be used in wetlands, due to the low oral toxicity to human and animals. Rodeo, or Aqua Master, is the recommend product of glyphosate to be used on the Boat Ramp enhancement areas. Rodeo is superior to Round-up in this context as it does not contain surfactants that both Roundup Pro and Roundup Ultra have.

Given the City's direction to consider other feasible options first before defaulting to herbicide use, other strategies discussed below could be utilized as initial procedures to knock down the dominant invasive plants in advance of planting. A pre-emergent herbicide should be considered at the time of planting to address the dense seed bank stored in the soil that will regenerate. As well, subsequent applications of herbicides and/or strategies discussed below may be employed as part of an adaptive management strategy. Herbicides will be hand painted on stems or stumps or injected, when used, near wetland, riparian areas, and areas of special concern.

There is potential to reduce the amount of non-native weeds on this site without chemical applications. Mowing and scraping is recommended before the annual weeds set seed prior to grading activities. Mowing should be employed in the spring and follow up mowing during the growing season, or in the fall will reduce undesirable seed set. By controlling herbaceous weeds the growth and survival of newly planted or seeded material will be greatly enhanced.

Table 7. Herbicides Approved for Specific Use

Product and Type	Ingredients	Limitations / Notes
Aqua- master (equivalent to Rodeo) --herbicide in Water	glyphosate, isopropylamine salt 53.8%	May damage non-target plants. Use for emergent plants in ponds, lakes, drainage canals, and areas around water or within watershed areas. Only as a last resort when other management practices are ineffective. NOTE: Equivalent to "Rodeo Emerged Aquatic Weed and Brush Herbicide," an older product. Rodeo in storage may be used under the same limitations. Note prohibition on use within buffer zone (generally 60 feet) around water bodies in red-legged frog habitat.
CMR Silicone Surfactant --adjuvant	polymethylsiloxane, nonionic	Use other alternatives pending new review of siloxanes
Eco Exempt HC --herbicide	eugenol (clove oil) 21.4%; 2-phenethylpropionate 21.4%	Do not use in enclosed areas.
EZject Selective Injection --herbicide	glyphosate, isopropylamine salt 83.5%	Tree stump injection especially where resprouting is likely, prefer mechanical methods when possible
Garlon 4	triclopyr,	Use only for targeted treatments of invasive exotics via dabbing or

--herbicide	butoxyethylester 61.6%; nonpetroleumbased methylated seed oils	injection.
Garlon 4 Ultra --herbicide	triclopyr, butoxyethyl ester 60.45%	Use only for targeted treatments of invasive exotics via dabbing or injection.
Milestone --herbicide	Aminopyralid, triisopropanolamin e salt (5928) 40.6%	For invasive species in natural areas where other alternatives are ineffective, especially for invasive legumes and composites such as yellow star thistle and purple star thistle. *Listed as Tier I due to persistence but toxicity & potential exposure are very low.*
Roundup Pro --herbicide	glyphosate, isopropylamine salt 41%	Spot application of areas inaccessible or too dangerous for hand methods, right of ways, utility access, or fire prevention. Use for cracks in hardscape, decomposed granite and edging only as last resort. OK for rennovations but must put in place weed prevention measures. Note prohibition on use within buffer zone (generally 60 feet) around water bodies in red-legged frog habitat.
Roundup ProDry --herbicide	glyphosate, ammonium salt 71.4%	Same limitations as Roundup Ultra
Sonar A.S. --herbicide in water	fluridone 41.7%	Emergent plants in ponds, lakes, drainage canals. Only as a last resort when other mgmt. practices are ineffective.
Turflon Ester --herbicide	triclopyr, butoxyethyl ester 61.6%	Targeted treatment of turf; broadcast application requires exemption. Note prohibition on use within buffer zone (generally 60 feet) around water bodies in red-legged frog habitat.
Source: San Francisco, City of, 2009. *SF Reduced Risk Pesticide List*. City Department of the Environment. http://www.sfenvironment.org/. April 13, 2009.		

Grazing

Light grazing can be an alternative mechanism to maintain open communities and eliminate invasive species, although overgrazing can result in damage including soil erosion. Overgrazing can be prevented with fencing and rotational grazing.

By itself, grazing may not be effective in completely eradicating invasive plants. When combined with other treatment control technique(s), such as herbicides or biocontrol, severe infestations can be reduced and small infestations may be eliminated. Grazing may be particularly appropriate in areas where herbicide application is not an option such as near water or where such application would be prohibitively expensive (such as extensive and dense infestations or tough terrain), or where tough terrain makes the site inaccessible to equipment. Precautions should be made to not spread invasive seeds as animals are moved from pasture to pasture. Grazing during seed or flower production can be especially useful at damaging the invasive species without significantly impacting the desired native species. It should be noted though that some species such as cheatgrass (*Bromus tectorum*) will become unpalatable once seeding begins due to stiff awns on the flower. Sheep and goats prefer broadleaf herbs. Goats can stand on hind legs to reach higher and as well tend to graze on a wider range of weedy species. Another consideration is availability of the animals for rent or purchase and transportation to the project site. Temporary fencing would be needed to manage animals within plots if grazing is utilized.

Grazing of goats was successfully utilized for the Skagit River Restoration project in the state of Washington, by The Nature Conservancy, where the particularly tough terrain and nature of the site as a restoration project were the main concerns driving invasive species removal methods. The five acre site used 30 goats (moms and kids) rented from Akyla Farms, for a five week period in the early summer, to manage an eight-foot high bramble of blackberries that was

pervasive across the project site. Planting of native species was conducted in the fall after the goats were removed and prior to the rainy season.

The goats should be penned for at least 3 days and fed alfalfa without seeds prior to being brought on site to ensure no additional invasives will be brought on site as a result of their presence. At the Boat Ramp sites, use of grazing would likely require exclusion fencing from areas with special status listed plants. California Grazing is one company in the area that could assist in this option.

Mowing

Where grazing (or fire) is not practical, mowing is sometimes used as a surrogate method of maintaining open grassland structure, as is practiced at nearby Edgewood Park (Friends of Edgewood Natural Preserve, 2008). Green machines and mowers can be used on a routine basis to weed around plantings as needed. The weed management should be done in late summer until plants are established. Stakes or exclusion fencing would help to keep the mowers away from the listed plants. Machinery should not be used at the site during wet conditions. Mowing is difficult on steep, rough, and varied terrain; however slopes are gentle to moderate at this site. Height and timing of mowing should be planned to avoid impacts to sensitive species.

Mowing should be done a few times throughout the year. Mowing is a remedy that works well to combat unwanted grasses from the restoration site and should be timed in careful consideration to the SFGS and not within the highly sensitive area of the fountain thistle serpentine grass and seep inclusion areas. In consideration of the SFGS, a higher blade height is better and avoidance of peak activity periods is recommended. Mowing in late February through April has been successful in coastal areas (Anderson, 2001). A second summer mowing in June or late spring helps to provide light to the young perennials and reduces the height of non-natives. The combination of mowing and herbicide has good results for controlling late season weeds.

It is always best to identify sensitive plants and there flowing period before mowing, and to avoid peak activity periods for SFGS and CRLF.

Mechanical Removal

Mechanical clearing can be applied to the scrub shrub area designated for grassland re-establishment. This is a mulching device that will clear the undesired woody material including: Monterey Cypress and pine, large infestations of pampas grass, coyote brush, and poison oak.

Hand Removal

The advantages of hand pulling include low ecological impact, minimal damage to neighboring plants, and low cost for equipment or supplies. Pulling is extremely labor intensive, however, and is effective only for relatively small areas, even when abundant volunteer labor is available. Weed wrenches and other tools can be used to remove large sapling and shrubs that are too big to be pulled by hand. The wrench locks onto the base of the stem and leverage is used to remove the entire plant. The weed wrench is effective on many trees and shrubs up to 2.5 inches in diameter even on steep slopes. This method is best when the ground is moist in the winter or spring (January –May). Some soil disturbance will occur with removal, and the bare soil may favor new seedling sprouts. To minimize soil disturbance, soil should be replaced to disturbed areas. Trampled and disturbed areas can provide optimal germination sites for additional weeds, and replanting and use of seed mixes and/or erosion control mix is important. Hand pulling of plants will need to repeated and continued for many seasons until the seed bank is exhausted.

6.1.8.4 Planting Preparation to Reduce Weeds/ Initial Weed Control

To decrease the weed seeds during the initial seedbed preparation it is important to remove weed seeds or till at least one year before planting with the native grasses. In March or April tilling or disking is effective at reducing the amount of winter growing annuals that set seed. This area should be left empty and should continue tilling in the summer months followed by an herbicide application to reduce late germinating vegetation. This method increase soil moisture for fall planting; sometimes smoothing the site after the first fall rain if soil clods are large. Weed control is still necessary at this stage as the seedbank is vast when it comes to non-native grasses and forbs, and they can still overwhelm a native a densely seeded area (Anderson, 2010).

A broadleaf post emergent herbicide is recommended to start especially for plants like the yellow star thistle and the jubata grass. After the first rains in October that assists with seedling germination, an herbicide application of glyphosate should be considered. For best results this method should be followed by flaming. These methods are effective because they eliminate bringing the seeds to the surface reducing the competitive abilities. If it an unusual rain year, it is possible to plant the site before the weeds emerge and follow with a glyphosate spray application prior to the natives emerging (approximately 7-10 days after germinating rains). Timing can be confirmed by monitoring when the native seeds first produce a radical, known by digging up a few plants after about two weeks in October or November. If it a normal rain year, then the site can be directly drill seeded. In order to maximize the year of first growth, seeding is before mid November, before summer dormancy (Anderson, 2001). No till range drill are the best for California native grass, due to the long awns of seeds which can cause mechanical failure with conventional broadcast and hydro-seeders.

6.1.8.5 Invasive Species Removal Strategies

The following species known to occur at the project site will be discussed individually: Pampas grass, French broom (*Genista monspessulana*), fennel (*Foeniculum vulgare*), Harding grass, cotoneaster *(Cotoneaster franchetti),* yellow star thistle (*Centaurea solstitialis)*, teasel *(Dipsacus* sp) and tocalote (*Centaurea melitensis*) wild oats (*Avena fatua*), poison hemlock (*Conium maculatum*).

Pampas grass *(Cortaderia sp.)*
There are two species of pampas grass onsite, *Cortaderia selloana* and *Cortaderia jubata*. *Cortaderia selloana* (true pampas grass) can be a problem along the central and southern California coast. *Cortaderia jubata* (jubata grass or Andean pampas grass) is highly invasive throughout coastal California. Andean pampas/jubata grass colonizes bare and disturbed ground. It invades roadsides, cutbanks, dunes, coastal bluffs, rock outcrops, landslides and logged lands. Unlike Scotch broom, it does not easily colonize native grasslands. A small to medium size stand of pampas grass was observed in the southeast part of the site during fall 2009 visits. Considering the size of the population it is recommended to manually remove the plant.

- *Mechanical:* Pulling, digging, or using a weed wrench while the plants are small is best. Small ones are easily pulled by hand when the soil is moist. Medium sized plants can be removed with a weed wrench; winter and spring are good seasons. A Pulaski or shovel is useful when a plant is too large to pull safely by hand.

The mature plants are very difficult to remove by hand. It is possible to undercut and remove one using a combination of pulaski and shovel. The easiest way is to place a choker cable around the plant's base and pull it out with a winch. The soil must be moist. Winter and spring are good seasons. For best results, the top section of the roots and the entire crown should be removed. If bagging and disposal is too difficult, designate a stockpile area and cover with a black weed mat to shade out material and allow for compost. Cutting the plumes off and placing them in bags helps to prevent further seed dispersal. The plumes cannot be cut and left on bare ground. The seeds will sprout. Depending on timing of construction activities it may be possible to remove the large pampas grass plants from the AGG site using grading equipment for the riparian areas, as this species was found along the southeast portion of the project site.

Providing an environment conducive to rapid growth of native trees produces shade adequate to exclude Pampas grass. The quality of environment for growth of natives is improved by reducing Pampas grass' competition. Over-seeding the disturbed area after removal can be an effective measure of preventing a reoccurrence of seedlings. Some resprouting may occur with these treatments and follow-up management will be necessary for future flushes of seedlings (Food and Agriculture, CA Department of, 2009).

- *Chemical*: For pampas grass, cutting and treating stumps with herbicide is an effective measure that reduces soil disturbance. Glyphosate applied as a 2% solution or eight qts/100 gallons for spot application has been an effective treatment for post emergent control (Cal-IPC). Fall application is best. For *Cortaderia jubata* it has been noted that only 20gallons per acre of glyphosate at 4% is also effective and can reduce the amount of herbicide and cost. For larger masses, it would be most effective to cut the upper plant foliage and then treat, this will also reduce the overall quantities of herbicide to be applied. This method will be applied as a last resort for this project.

French broom (*Genista monspessulana*)

These species have the tendency to invade grasslands, scrub and woodlands; the entire site is vulnerable to the invasion of these woody intruders. Spanish broom has a deep taproot up to 6 feet making it difficult to remove, more so, than French broom. The most effective way to control the brooms are by repeated hand pulling or burning though repeated hand pulling yielded the highest native cover (Alexander, and D'Antonio, 2003). Removal can be achieved using a combination of the following processes:

- *Manual:* The weed wrench is one of the most effective techniques for the complete removal of broom. Established infestations are difficult to eliminate because large, long-lived seedbanks typically accumulate. Minimizing soil disturbances, monitoring, and repeated manual pulling of young plants when discovered can help prevent new infestations. Repeated pulling of successive generations is currently thought the most effective method, if that level of management is feasible. A flush of broom seedlings may occur directly beneath the previously canopied area after mechanical removal.

- *Mechanical:* Mowing or cutting the shrubs may prevent seed production; however, resprouts will still need to be managed. Machines and tools used to remove stands may inadvertently transport seed to uninfested sites. Cutting broom shrubs to ground level at the end of the dry season can help reduce re-sprouting from the crown. Cutting plants and girdling (peeling bark down to ground surface) is an additional measure to dissuade resprouting. Planting native shrubs and trees within and around broom stands can

eventually help to minimize infestations by shading (Food and Agriculture, CA Department of, 2009; and Cal-IPC, 2004). Cutting and treating stumps with herbicide is an effective measure that reduces soil disturbance.

- *Grazing*: Intensive goat grazing has been used to control brooms. Goats are most effective in controlling regrowth following initial control strategies. Goat grazing may be difficult if trying to reestablish natives during the control process since goats will also likely browse the native plants. Goats confined to a small area can help control stands of young shrubs or young re-growth from cut shrubs (Food and Agriculture, CA Department of, 2009).
- *Chemical*: For brooms, glyphosate applied as a 2-3% v/v foliar spray has been an effective treatment. It is recommended on this site to use Triclopyr applied as a 25% basal bark application in an oil carrier after cutting older plants if they are not fully removed by a weed wrench or Pulaski. Some resprouting may occur with these mechanical treatments and follow-up pulling, or herbicide management may be necessary for future flushes of seedlings (Food and Agriculture, CA Department of, 2009). Cutting and treating stumps with herbicide is an effective measure that reduces soil disturbance.
- *Disposal:* Pulled plants that have not gone to seed can be composted on site. Plants that have gone to seed should be immediately tarped and/or bagged and removed from the site for disposal.

Yellow star thistle (*Centaurea solstitialis)*: This plant is a vigorous winter annual able to reproduce over 30,000 viable seeds annually. Of the seeds that don't germinate they can live in the seedbank for at least 3 years. This thistle is has a long germination period going from fall through spring. This plant is known to reduce soil moisture where it grows and once it germinates it quickly produces a long root that expands approximately 3 feet allowing the plant to outcompete shallow rooted plants. This plant often occupies grasslands due to the light availability (UC IPM).

- *Mechanical:* Mowing this plant when the seed heads are flowering at 2-5% can be effective. This is best applied when the lowest branches are above the height of the lawn mower. This technique should reduce recovery. To make sure seed reduction and cover of this plant is greatly reduced it may need two-three mowing and should be repeatedly monitored.
- *Chemical*: Glyphosate is the recommended post-emergent herbicide to be applied in the early spring or late winter. The best time to use herbicide is when the native annual grasses and forb have reached developmental maturity and before the thistle produces viable seed (May-June) (California Invasive Plant Council, 2010).

Fennel (*Foeniculum vulgare):* Fennel is a perennial herb with a thick tap root enabling erect growth that can reach 4-10 feet tall, with yellow flowers in growing in compound umbels most noticeable from April thru July. Vegetative growth occurs between mid winter and peaks in July to august. This plant has no problem occupying a variety of habitats including grasslands, coastal scrub, and even mesic habitats outcompeting native plants in these areas. Fennel can reproduce from the root crowns and from seed that is dispersed by water. Seeds can last for a long time in the soil without germinating, and germination of seeds can occur throughout most of the year. Stems die in the late fall, though some can stay alive and continue to grow with winter rains.

- *Manual:* The best way to remove this plant by manually pulling small infestations. Though it is labor intensive this method minimizes soil disturbance and is better than mechanically removing with a plow or bulldozer, cutting or copping. If you cut the plant several times to reduce the spread of seed may work over time, but this plant can regrow with minimal disturbance. Leaving the root in place can allow for the plant to resprout. Therefore, this plan recommends hand pulling as the most effective method.
- *Chemical:* If deemed appropriate and not in the vicinity of sensitive habitat to be restored on the site, Garlon has proven to kill almost 100% when applied in the early spring.

Slender oats (*Avena barbata*): This species is a cool season annual found in grasslands, oak savanna, and many other habitats. This plant reproduces by seed near the plant and seeds are transported further away by animals, and humans.

- *Mechanical:* Mulching can be a very effective measure at suppressing this species. Mowing before the grass sets seed is also effective.
- *Grazing:* For the grass species, grazing in advance of native plantings could be highly effective in providing an initial reduction in this species.
  Chemical: Applying either or both pre and post emergent herbicide as discussed for other species will also be effecting at controlling this annual grass.

A strategy that employs multiple methods as well as monitoring and adaptive management will be essential for long-term success of the target habitat where this plant is currently found. For the grass species, grazing in advance of native plantings could be highly effective in providing an initial reduction in this species. Implementing invasive species control methods in advance of the planting schedule is recommended.

Poison hemlock (*Conium maculatum*): Poison hemlock is a plant that has the ability to spread rapidly in a wide variety of settings from roadsides, to open meadow, fields and pastures, to more mesic habitats of riparian and floodplain habitats. This species does particularly well after a good rain in cleared or disturbed areas. This plant is poisonous to humans, and wildlife - including vertebrates and livestock. Poison hemlock has a long temporal window for seed dispersal from September thru December and some remaining seeds dispersed in February (California Invasive Plant Council, 2009).

- *Mechanical:* Multiple mowing efforts have been effective at controlling this species if timed correctly. Spring mowing is encouraged, with a follow up mowing in the late summer to kill the regrowth of some individuals and new seedling establishment. Lastly, a third mowing should take place in year three after initial control has started due to the seed bank staying viable for up to three years.
- *Manual:* Hand pulling is an effective method of controlling this biennial herbaceous plant. The best time to hand pull is when the soil is moist and prior to the plant setting seed. The reproductive parts of the plant occur after the first year of germination in mid-April with the seed being completely developed by mid-June. Follow up pulling is necessary to eliminate remaining and subsequent growth. The roots do not need to be grubbed.

Teasel *(Dipsacus sativus):* This is a biennial perennial herbaceous plant that blooms between July and October. This plant can be found in mesic to xeric habitat. This plant species produces 2000 seeds, of which 30-80% will germinate with seeds staying viable for up to two years. The seedlings are typically found close to the parent plant, though it can be dispersed by water

increasing its range (Wisconsin Department of Natural Resources, 2004).

- *Mechanical:* Cutting and/or digging are thought to be the best solution to remove this plant. Using a simple hand removal weed tool, such as a dandelion digger. The entire root should be removed to ensure no respouting will occur from root fragments. If a shaor spade is used, be cautious to not fragment the root. Another option is to cut the stalk before it before the full bud stage inducing mortality of the specimen, and the plant should not reflower. In both situations the plant parts should be removed from the site. If the plant has been cut and the flowering stalk is left behind it seeds may still be able to mature after cutting.

Harding grass (*Phalaris aquatica*)
This species grows in large clumps along the coast and can be found invading grasslands, rangelands, roadways and waterways. This plant has a deep tap root allowing it to tolerate drought. This perennial grass spreads by seed (produced May through September) but also by rhizome. Seeds last between 1-3 years. The best time to control this weed is in the dry summer months of June and July. Before this time it is too difficult to distinguish the grass and after this window the grass has already gone to seed making the herbicide ineffective (RNSP, 2008).

- *Mechanical:* Cutting around the base clump with a Pulaski and digging out all roots longer than 2 inches can be effective in controlling this species. Mulching is recommended to discourage re-sprouts. If mowing is implemented, it is recommended to be very close to the ground and to occur at least three times within the growing season to keep the plants from overtaking growth of target native species. Mowing should occur late in the growing season (spring for this species) when soil moisture is low or depleted. Cutting the grass when it is flowering will reduce the vigor of new shoots. Repeated mowing of this species can reduce the seed bank and prevent expansion and new growth, but will not eliminate the species. Disking and reseeding is a mechanical alternative to mowing. However, mowing is only a control, and does not entirely eradicate the grass.
- *Grazing:* can effectively decrease abundance of this species and it is known to be planted for forage, but can be toxic when consumed in large quantities by animals.
- *Chemical:* After mowing close to the ground, a Glyphosate (Aquamaster) herbicide can be applied to reduce the amount of effort needed for mowing or if mulching is not a desired option due to the potential of suppressing desired plants. (Cal-IPC, 2004).
- *Disposal:* bagging seed heads and disposing is thought to be the best for this species, though it can be composted in a pile on site as long as the debris doesn't contain material that went to seed.

Cotoneaster *(Cotoneaster franchetti):*
This plant is an erect, evergreen flowering shrub that grows up to 10 feet tall. This plant has zig zag branches that start at ground level. The leaves are up to ¾ inch long, gray-green, simple and hairy on the bottom side. The flowers are abundant and can be seen in June through September, and the red berries are distinguishable from September through February. This plant has great success from the number of seeds it produces which don't need fertilizer to germinate. Birds have a way of dispering this plant far beyond the parent source of seed. This pant can also spread by the roots and branches that can root at the nodes (Cal ipc, 2004).

- *Manual:* The weed wrench is one of the most effective techniques for the complete removal of this plant if it a half inch or less DBH. Minimizing soil disturbances, monitoring, and repeated manual pulling of young plants when discovered can help

prevent new infestations. Pulling is practical if used on small plants, due to the fact that this shrub has multiple stems and is difficult to pull from the base as it gets older. It is important to remove the entire plant as it does reproduce from stump sprouts. Repeated pulling of successive generations is currently thought the most effective method, if that level of management is feasible.

Mature plants can be controlled by cutting no lower than 1 inch from the ground surface just after berries are produced, but before the berries drop. This method takes into account that the stems will produce sprouts from the roots or trunk if it is cut any lower, and by not waiting for the berries to fall the risk of new propagules is minimized to seed already in the soil. This method includes covering the stump with a shade mat, black cloth, or landscape fabric for at least a year. Fabric should be checked two times a year, and cutting new growth that survived under the fabric is ok as long as it is replaced securely.

- *Chemical*: Cotoneaster can be treated with the spot application technique or using a paint brush on the freshly cut woody stems, using a 50% concentration of glyphosate It is recommended on this site to use Triclopyr applied as a 25% basal bark application in an oil carrier after cutting older plants if they are not fully removed by a weed wrench or Pulaski. Some resprouting may occur with these mechanical treatments and follow-up pulling, or herbicide management may be necessary for future flushes of seedlings (Food and Agriculture, CA Department of, 2009). Cutting and treating stumps with herbicide is an effective measure that reduces soil disturbance.
- *Disposal:* Plants can be piled on site and covered, chipping is recommended for larger material.

Velvetgrass (*Holcus lanatus*)*:* A strategy that employs multiple methods as well as monitoring and adaptive management will be key in long-term success of the target habitat. For invasive grass species and other non-native annuals, grazing in advance of native plantings could be highly effective in providing an initial reduction in this species. Implementing invasive species control methods in advance of the planting schedule is recommended.

- *Mechanical:* For small isolated patches it is possible to remove the clump of grass by hand before the seed sets. The plant can also be removed by cutting at the base with a paring knife. This is most successful during the winter rainy season from January through April. Weed whacking then scraping is another method used to control the grass before the seed set. Chopping the root crown using a blade or McLeod is another option. Cutting patches of the grass in the spring followed by mulching with 4-6 inches of onsite material has been used to suppress resprouts in small areas. Follow up treatments are necessary for all hand methods.
- *Disposal:* The plant material should be bagged and disposed of offsite.

6.1.8.6 Undesirable Native Species Plant Control

Monterey cypress (*Cupressus macrocarpa*), Monterey pine (*Pinus radiata*), are native to California, but not to the Boat Ramp site. Coyote brush and poison oak are native to this region, yet they are encroaching on grassland habitats due to alterations in the disturbance regime, and currently occur at higher level of abundance of what occurred historically. Though these plants are native to California they tend to alter the nutrient and hydrology cycle when they go beyond their range into grassland and prairie habitats. A combination of techniques will yield the most

successful reduction of these species. These trees and shrubs and their control methods are discussed individually below.

Coyote brush *(Baccharis pilularis):* Coyote brush is a perennial, evergreen shrub native to California where it is found in northern coastal scrub, foothill woodlands, mixed evergreen forest, and coastal stands communities. This plant typically blooms from August to September. As a result of decreased burning and grazing this plant has become intrusive to native grassland ecosystems.

- *Mechanical:* Mechanical removal of this shrub will likely be the next best method for removing the shrub from this site. Wood should be cut and dried prior to removal for burning. Small material may be composted on site. It is not recommended to chip this material do to the poisonous nature of the material and for its ability to reproduce from root fragments.
- *Chemical*: For coyote brush, glyphosate or Triclopyr applied as a basal stem application has been an effective treatment. It is recommended on this site to use Triclopyr, which has a wider treatment window and can be applied as a 25% basal bark application in an oil carrier after cutting older plants.
- *Disclaimer:* it's OK to leave a few shrubs, which are too close to thistle to remove safely

Monterey cypress *(Cupressus macrocarpa):* Monterey cypress is a native tree to the Monterey Watershed in California, but not the Peninsula watershed. This tree was previously planted in the Peninsula Watershed as an ornamental landscape plant, for windbreaks, and for erosion control. This evergreen tree has the ability to change the ph in soil and has started to out-compete native flora and coastal vegetation types, including north coastal scrub, coastal prairie, riparian scrub, woodland, and forest. This tree can create a large canopy contributing to a high cover throughout the project region and as a result has a sparse understory where it found. The seeds can up to 4 years in the cones before they hit the ground. A majority of the infestation is patchy in the project area, where seedlings are found next to the adult tree and cultivated stands. The cypress tree does not regrow from the stump or resprout allowing for manual and mechanical removal of this species to be sufficient. Follow-up monitoring is appropriate to ensure that new seedling emergence is removed as quickly as possible.

- *Mechanical:* Mechanical removal of this tree will likely be the most effective method. Wood may be cut, dried or chipped prior to removal for burning. Small material may be composted on site. Two trees will be girdled and left standing to provide habitat structure.
- *Manual:* For small specimens, seedlings and as a follow-up treatment of this plant, manual pulling is the best method to remove this undesired tree and reduce soil disturbance.

Monterey pine (*Pinus radiate):* Monterey pine is an evergreen tree found to be native in only three places within California, were it is considered to be threatened. This was once a cultivated tree in California where these source populations have escaped there areas of cultivation and now threatened other sensitive habitat types. This plant was previously planted within the Peninsula Watershed where it is currently found in monotypic stands outcompeting native flora in this region. The tree has the ability to augment the ph of soils where it is found. This tree is commonly found to be associated with coast live oak woodlands, northern coastal scrub, northern coyote brush scrub, and serpentine grassland environments which are of interest to this MMP report. Approximately 134 data points of this species have been mapped within the watershed by Nomad Ecology, where it is considered to be a widespread issue. This plant tends

to support a native understory and caution should be taken when removing individuals from the project area. This tree does not resprout after cutting; therefore manual and mechanical removal of this species is recommended for full eradication and control of this plant. In order to achieve full eradication of this species within the project area, follow-up monitoring for seedlings is encouraged throughout the monitoring timeframe of the project.

- *Mechanical:* Mechanical removal of this tree will likely be the most effective method. Wood may be cut, dried or chipped prior to removal for burning. Small material may be composted on site.
- *Manual:* For small specimens, seedlings and as a follow-up treatment of this plant, manual pulling is the best method to remove this undesired tree and reduce soil disturbance.

Poison oak *(Toxicodendron diversilobum):* Poison oak is a native deciduous shrub to California. This plant is common in riparian environments where it can tolerate shade where it can grow as a vine and use adventitious roots for climbing nearby shrubs and trees; and in the more open environments such as the coastal grasslands where it can take the forms of a dense shrub thicket. This plant cannot be killed by cutting it down, as it has a strong root system and requires the termination and removal of the entire specimen to control or eradicate it from a specific location.

- *Grazing:* Intensive goat grazing has been used to control poison oak and is the main recommendation for controlling this species. Goats are most effective in controlling regrowth following initial control strategies. Goat grazing may be difficult if trying to reestablish natives during the control process since goats will also likely browse the native plants. Goats confined to a small area can help control stands of young shrubs or young re-growth from cut shrubs (Food and Agriculture, CA Department of, 2009). Grazing is also encouraged before a prescribed burn to reduce fuel and thatch.
- *Mechanical:* Mechanical removal of this shrub will likely be the next best method for removing the shrub from this site. Wood should be cut and dried prior to removal for burning. Small material may be composted on site. It is not recommended to chip this material do to the poisonous nature of the material and for its ability to reproduce from root fragments.
- *Manual:* For small specimens, seedlings and as a follow-up treatment of this plant, manual pulling is the best method to remove the undesired shrub and reduce soil disturbance.
- *Chemical:* Stump application can be effective at controlling these species during active times of growth. Immediately after cutting the shrub 2 inches above the ground surface, apply the stump with either glyphosate or triclopyr using a point brush. Basal applications are also effective at controlling this plant and this method can be utilized any time of year. Applying the chemical to 6-12 inches of the basal section is adequate coverage (DiTomaso, 2009).
- *Disclaimer:* it's OK to leave a few shrubs, which are too close to thistle to remove safely.

6.1.8.7 Equipment Sanitation

After the initial invasive species management has taken place it is imperative that machinery be cleaned and inspected for soil and debris. Excavation and earth moving equipment can become contaminated with invasive seed stock. The machinery should be cleaned in an upland area near the areas where invasive were removed. The equipment should be cleaned with a mobile pressure washer. The purpose is to prevent unwanted seed stock or propagules from entering

unaffected areas, or areas where removal has occurred. Furthermore, this prevents unwanted herbicide (if used) from entering natural areas.

6.1.8.8 Waste Material Removal

Waste material cut from some invasive species including pampas grass and yellow star thistle need to be removed from the site by hand where practical, by placing waste in plastic bags or tarps, to prevent rerouting and seeding of waste material. Waste material should be burned, composted on site, or disposed of in a landfill.

6.2 Planting Material

6.2.1 Plant Species List

A detailed planting plan, broken down by wetland and serpentine grassland community types is presented in Table 8, and these planting zones can be viewed in Figure 11.

This figure includes revegetating the entire fountain thistle project area with a serpentine bunchgrass plant palette; in addition to serpentine bunchgrass planting, in the southwest portion of the fountain thistle site is an area where fountain thistle is anticipated to have substantial recruitment in year one, and is delineated on the map. Another area where fountain thistle seeding and transplanting will occur in year two is also shown on Figure 11.

Bare soil areas less than five feet shall not be covered in the serpentine grassland enhancement area due to the fact that the Marin dwarf flax among other special status plant species thrive on bare soil. Bare soil areas greater than 5 feet should be covered with a maximum of one inch of sterile mulch, which will protect area from erosion and reduce revegetation from non-native weedy species. This method should only be prepared when there is no chance of rain to occur within a 24 hour period. The seed cannot sit in the slurry for greater than 30 minutes (depending on the supplier).

Table 8: Planting Plan (Approximate Quantities)

			PLANTING ZONE		A	B	C
			Recommended Minimum PLS[7]	% of Seed Mix	**Serpentine Grassland**	**Seasonal Wetland**	**Erosion Control** [5]
Boat Ramp Sites		Planting Acreage			5.5	0.5	1.0 [8]
Wetland	*Salix lasiolepis* [1]	arroyo willow				10	
	Scirpus acutus [2]	bulrush				75	
	Juncus effusus [2]	common rush				75	
	Juncus patens [2]	spreading rush				75	
	juncus xiphiodes [2]	iris leaf-rush				100	
	Carex barbarae [2]	Santa Barbara sedge				100	
	Mimulus guttatus [2]	seep monkeyflower				100	
	Eleocharis macrostachys [2]	common spikerush				75	
Fountain Thistle/Spring seep	*Cirsium fontinale var. fontinale* [10]	fountain thistle					
	Deschampsia caespitosa var caespitosa3	tufted hairgrass			15 lbs		
	Hordeum branchyantherum	meadow barley			10 lbs		
	Leymus triticoides [3]	creeping wildrye			15 lbs		
	Nasella lepida [3]	foothill needlegrass			15 lbs		
	Melica californica [3]	melic grass			15 lbs		
	aster chilensi [3]	Pacific aster			10 lbs		
	Danthonia californica [3]	California oatgrass			10 lbs		
	Sisyrynchium bellum [3]	blue-eyed grass			10 lbs		
			TOTAL	**100%**	**110 lbs**		
Butterfly Enhancment [9]	*Eriogonum latifolium*	coast buckwheat			100		
	Lomatium dasycarpum	hairy-fruited lomatium			100		
	Lupinus albifrons	silverleaf lupine			100		
	Castilleja densiflora	purple owl's clover	25	20%	8 lbs		
	Castilleja exserta	exserted paintbrush	25	20%	8 lbs		
	Eschscholzia californica	California Poppy	72	5%	2 lbs		
	Lasthenia californica	California goldfields	30	20%	8 lbs		
	Layia platyglossa	tidy-tips	56	20%	8 lbs		
	Plantago erecta	California plantain	73	15%	6 lbs		
			TOTAL	**100%**	**40 lbs**		
Erosion Control Mix	*Bromus carinatus* [5,6]	California brome	70	30%			20 lbs
	Elymus glaucus [4]	blue wild rye	72	30%			20 lbs
	Festuca rubra [5]	red fescue	80	5%			5 lbs
	Lupinus bicolor [5]	bicolor lupine	78	5%			5 lbs
	Nasella pulchra [5]	purple needlegrass	63	25%			5 lbs
	Vulpia microstachys [5,6]	three week fescue	80	5%			5 lbs
			TOTAL	**100%**			**70 + 70 lbs**

6.2.2 Sources and Storage

In order to preserve the unique genetic diversity if the Peninsula watershed, plants will be purchased from nurseries and will be grown from local stock. Plants will be purchased from nurseries and will be grown from local stock. The nurseries should be selected well in advance so that adequate quantities and sizes of species will be available at time of planting. Prior to site clearing and construction, it is possible for restoration contractors to collect seeds and transplants depending on the schedule. By collecting seed from sources in close proximity to the site, and within the boundaries of the watershed, there will likely be high success due to the well adapted ecotypes being utilized.

Fountain thistle propagation will follow special endangered species recovery permit conditions pending the completion of consultation and permit issuance by USFWS. Propagation should be timed to make stock available over a multi-year period beginning in year two of the implementation of this plan so ensure adequate permits are in place for either seed collecting or transplanting.

Willow (*Salix* sp.) Planting Instructions: Willow cuttings can be taken from large vigorous-growing shrubs and trees from December 15 through February 1 (when plants are dormant) prior to bud swelling. The willow-cutting source shall be within a 15-mile radius of the project area.

Length of cuttings shall be three feet with a minimum ¾ inch diameter at the base and maximum of three inches. It is recommended that the bottom of the willow cuttings be cut at a 45-degree angle in order to keep track of the correct orientation of the cutting and to facilitate planting. Cuttings shall be placed in a bucket filled with water prior to planting to avoid desiccation and shall be planted within 24 hours of cutting. Willow cuttings shall be placed with the basal 2/3 of the slip in the ground, with approximately 10-12 inches above the soil surface. If holes are dug or augured for the willows the soil shall be tamped around each willow slip so no air void occurs.

6.2.3 Plant Sizes and Estimated Number of Installed Plants

The Planting Plan (Table 5) provides estimated quantity of each species based on acreage of area to be replaced and enhanced. Table 4 also provides recommended plant sizes and spacing, which are summarized below for reference:

A. Wetland establishment: Marsh perennials will be planted as bare root stock, with six feet on center spacing, 1,200 plants/acre.
B. Butterfly Enhancement: Perennials will be planted at D16 size from stock.
C. Serpentine and Butterfly Grassland Enhancement: Seed quantities for grasslands are calculated based on 20 pounds per acre for seed mix, (except where noted for erosion control mix that is 70 pounds per acre mix as well as 70 pounds per acre of sterile seeds for quick coverage).
D. Fountain Thistle: Fountain thistle transplants will be incorporated in year two after completion of clearing and construction has been completed and recovery permits to propagate the plant are in place. Timing and methods of seed collection and propagation are contingent on special conditions of recovery and other permits to be requested from FWS and DFG

6.3 PLANT INSTALLATION METHODS

6.3.1 Hydroseeding, Drill seeding and Broadcast Seeding

Hydroseeding may be employed in erosion control areas such as the toe of bordering slopes, if deemed appropriate. Broadcast seeding will likely be used for the serpentine and butterfly grassland seed mix (could also be used for erosion control mix). Drill seeding is applied using an 8-12 foot tractor towing a seed drill. This method should be used to sow seeds in the grassland enhancement and reestablishment areas, where scrub has been cleared, yet outside the exclusion fencing protecting the fountain thistle population. A biological monitor has verified that no burrows potentially harboring San Francisco garter snakes are present. Drill seeding will not occur where remnant grassland openings persist. Drill seeding rates are lower than broadcast rates and have a higher percentage of germination because seeds are drilled shallowly into the soil providing better contact with the soil medium and moisture.

6.3.2 Rooted Material Planting Methods and Protections

Holes will be dug to twice the size of the root ball. The holes will be refilled with native soil and gently tamped to reduce air pockets. An initial watering will be conducted to further eliminate air spaces and ensure adequate contact of the root surface with the soil medium.

Thistle will be propagated for year two (2012), after project clearing and initial revegetation implementation has occurred in 2011. This will allow for conditions to be written so that SFPUC can secure recovery permits under the Fish and Wildlife Service, and to allow establishment of a matrix of serpentine grassland and seepage indicator species, such as (*Deschampsia cespitosa ssp. Holciformis)*

6.3.3 Treatment of Cuttings and Other Non-Rooted Materials

Willow cutting collection and installation are described in Section 6.2.2.

6.4 WATER SOURCES AND IRRIGATION

Dry-season irrigation is not recommended for serpentine grassland planting. Tree plantings may not occur at these sites, so irrigation may not be necessary. Information on irrigation is retained in this document in the event that an existing oak near the access road is accidentally damaged during construction and needs to be mitigated through replacement.

6.4.1 Irrigation Methods

Water may be provided by drip irrigation system, spraying water from a water truck (only where access is provided by existing roads), sprinklers or a combination of methods. Water may be sourced from surface and/or groundwater sources that are available (and permitted) to the project Owner.

6.4.2 Frequency and Duration

Watering will occur at least until the onset of the cool weather/wet season and/or a prolonged period of early rain in the fall. If irrigation is ceased after two years and then it is restarted, then the monitoring period will extended by one year for each year of additional irrigation and the monitoring period will be reset to Year 1 to ensure the plants are self sustaining, based on Regional Water Quality Control Board recommendations.

Table 9. Number of Water Events Per Month (During Dry Season)

	1st Year	2nd Year	3rd Year
Trees, Shrubs, Perennials	3 to 4*	2 to 3	As needed
Seed Mix	2 to 3	As Needed	As needed
* = Once every 10 to 14 days			

6.5 IMPLEMENTATION SCHEDULE

The project is proposed for construction during the approved work window in year 2011. The construction window is likely restricted to the dry season to, among other things, reduce the potential for significant erosion to occur (a Stormwater Pollution Prevention Plan will be implemented, per RWQCB requirements). Planting shall be done between October 15 and November 15, 2011. The development of the mitigation and restoration area will be generally implemented according to the schedule shown in Table 10 below.

Table 10. Development Timeline

Task		Start Date
1	Invasive species removal, hand clearing and grubbing	Fall/winter 2010; July 5-August 30, 2011
2	Direct seeding of erosion and control palette after removing undesired vegetation	Within two days after hand clearing; September 15-October 30, 2011
3	Tree removal	August 15-September 30, 2011
4	Excavation and grading	September 15-October 30, 2011

5	Seed grassland and serpentine bunchgrass areas	October 15 – October 30, 2011
6	Seed disturbed areas with erosion control mix	September 15 – October 30, 2011 (or 2 weeks past end of grading)
7	Irrigation (if needed)	September 30-November 15, 2011
8	Planting uplands and wetlands	October 1, 2011-November 15, 2011
9	Complete as-built drawings	March 15, 2012
10	1st year Monitor grassland and wetland success	March 2012
11	Transplant and/or seed fountain thistle	October 15-November 15, 2012

7.0 SUCCESS CRITERIA

Performance standards for the Boat Ramp sites are intended to be measurable by systematic monitoring methods.

7.1 Hydrology Criteria

Hydrology

H1: During an average year of rainfall (25.86 inches[1]), the wetlands will hold water until at least May 1st (Hydrology Report, 2010. Appendix D).

H2: At the end of five years, wetland area will be increased by at least 0.39 acres as determined by a jurisdictional delineation.

H3: At the end of five years, existing seasonal wetland depth and duration of inundation will be equal to or greater than pre-project conditions as measured in the spring of 2010, assuming equivalent precipitation during pre and post construction monitoring periods. In order to account for annual variability of rainfall, hourly rainfall data from the San Andreas Cottage gage station, located approximately 1 mile northeast of the project area, and from the Crystal Springs Cottage gage station, located approximately 7 miles southeast of the project area will be analyzed to verify the hydrology model used to design the enhancement and creation of wetlands. This rain data is in calibration with a stream gauge installed in January 2010 (Hydrology Report, 2010. Appendix D, Figure 2).

7.2 Vegetation Criteria

V-1: For grassland communities post-planting cover shall meet the annual criteria identified in Table 11:

Table 11. Grassland Habitat Success Criteria	
Grassland	Absolute vegetative cover (of native and naturalized plant species) will be at least 55% after five years. Absolute cover of non-native, invasive species will not exceed 5%

[1] The historical volume quantities are based on hourly rainfall data from the San Andreas Cottage and Crystal Springs Cottage rain gages from October 1999 through March 2010 and the calibrated HECHMS model.

* Invasive species are defined in Section 6.1.8.1).

V-2: For wetland communities post-planting cover shall meet the criteria identified in Table 12:

Table 12. Seasonal Wetland Habitat Success Criteria	
Seasonal Wetland*	**Year 1:** 5 percent or greater absolute cover of native seasonal wetland species. No more than 5 percent absolute cover of target invasive plants*. No large unvegetated bare spots (greater than 25 percent) or erosional areas, no evidence of permanent inundation. **Year 2:** 20 percent or greater absolute cover of native seasonal wetland species. No more than 5 percent absolute cover of target invasive plants. No large unvegetated bare spots (greater than 25 percent) or erosional areas, no evidence of permanent inundation. **Year 3:** 45 percent or greater absolute cover of native seasonal wetland species. No more than 5 percent absolute cover of target invasive plants. No large unvegetated bare spots (greater than 25 percent) or erosional areas permanent inundation.**Year 4:** 60 percent or greater absolute cover of native seasonal wetland species. No more than 5 percent absolute cover of target invasive plants. No large unvegetated bare spots (greater than 25percent) or erosional areas, no evidence of permanent inundation **Year 5:** 70 percent or greater absolute cover of native seasonal wetland species. No more than 5 percent absolute cover of target invasive plants. No large unvegetated bare spots (greater than 20 percent) or erosional areas, no evidence of permanent Total Acreage meeting success criteria for hydrophytic vegetation, wetland hydrology to or greater than 0.05 acres of established seasonal wetland, and 0.17 acres of enhanced seasonal wetland.
* Invasive species are defined in Section 6.1.8.1	

V-3: There will be no net loss of fountain thistle individuals (total count and bloom count), relative to a baseline pre-project survey, per every year the reservoir levels are due to increase by one foot incremental inundation. (Table 13)

V-3a: The first one-foot incremental increase in MNWSE (to 284.8 ft) will not occur until it has been shown that the SFPUC has compensated for the fountain thistle plants that are currently present below 283.8 ft (which is the predicted maximum elevation of the effects to fountain thistle population for an MNWSE of 284.8 ft).

V-3b: The second one-foot incremental increase in MNWSE (to 285.8 ft) will not occur until it has been shown that the SFPUC has compensated for the fountain thistle plants that are currently present below 284.8 ft (which is the predicted maximum elevation of effects to the fountain thistle population for an MNWSE of 285.8 ft).

V-3c: The third one-foot incremental increase in MNWSE (to 286.8 ft) will not occur until it has been shown that the SFPUC has compensated for the fountain thistle plants that are currently present below 285.8 ft (which is the predicted maximum elevation of effects to the fountain thistle population for an MNWSE of 286.8 ft).

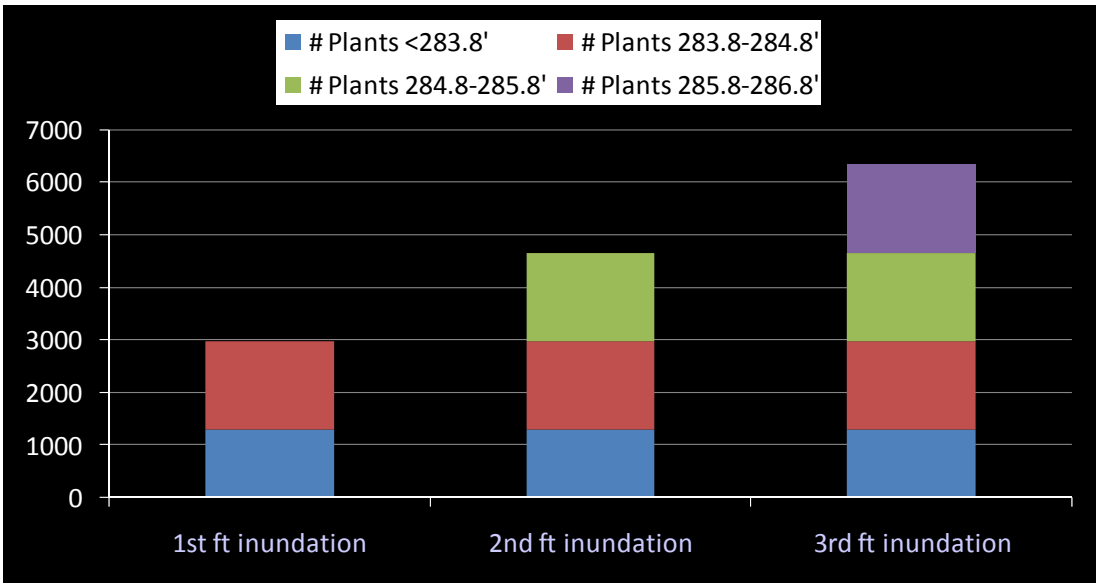
V-3d: The fourth one-foot incremental increase in MNWSE (to 287.8 ft) will not occur until it has been shown that the SFPUC has compensated for the fountain thistle plants that are currently

present below 286.8 ft (which is the predicted maximum elevation of effects to the fountain thistle population for an MNWSE of 287.8 ft).

Table 13: Maximum Elevation of Effects and Needed # of Compensation Plants

# of Proposed Increment Change in MNWSE	Change in MNWSE (feet)	Predicted change in the maximum elevation of effects to the fountain thistle population (feet)	# of compensation plants needed before the proposed incremental change in MNWSE	Cumulative compensation needed	# of compensation plants needed before incremental change in MNWSE, in addition to compensation required for previous incremental changes.*	Estimated **cumulative** total # of plants needed prior to incremental change in MNWSE can proceed.*
1	From 283.8 to 284.8	From 282.8 to 283.8	# of plants that currently occur below 283.8 ft	# of plants that currently occur below 283.8 ft	1,291	**1,291**
2	From 284.8 to 285.8	From 283.8 to 284.8	# of plants that currently occur between 283.8 ft and 284.8 ft	# of plants that currently occur below 284.8 ft	1,683	1,291 + 1,683 = **2,974**
3	From 285.8 to 286.8	From 284.8 to 285.8	# of plants that currently occur between 284.8 ft and 285.8 ft	# of plants that currently occur below 285.8 ft	1,683	1,291 + 1,683 + 1,683 = **4,657**
4	From 286.8 to 287.8	From 285.8 to 286.8	# of plants that currently occur between 285.8 ft and 286.8 ft	# of plants that currently occur below 286.8 ft	1,683	1,291 + 1,683 + 1,683 + 1, 683 = **6,340**
TOTAL # of plants that must be compensated before all four incremental increases can occur:*					**6,340**	

Replacement Plant Requirements



V-4: There will be no net loss of Crystal Springs lessingia relative to a baseline pre-project survey.

8.0 MONITORING

8.1 Hydrology and Soils Monitoring Methods

8.1.1 *Hydrology Monitoring*

Monitoring of hydrology will be completed through physical survey (topographic measurement for wetlands) of critical locations including the rim of the wetland edges, and where water flows into the site and where water flows off of the site. Physical survey of the wetlands will consist of surveying the limit of inundation and recording water levels on a gauge (to be installed as part of this project) within 10 days of a January storm event during a normal (or wetter) precipitation year. Precipitation and weather conditions will be documented. In the event of prolonged drought, extension of the monitoring period or other appropriate adaptive management may be proposed.

Methods for quantifying the geomorphic and hydrologic function of the wetlands will include:

1) Installing a staff gage within the wetland for the purpose of measuring depth and duration of inundation as well as sediment accumulation within the wetland. During the rainy season, the staff gages shall be monitored at a minimum of one time per month or after storm events that exceed 2-inches in depth according to the Crystal Springs Cottage (CSC) rain gage operated by SFPUC. After the rainy season, the draw down time shall be monitored by observing the inundation depth on a weekly basis for the first year and every 1 to 3 weeks for subsequent years based on the calculated draw down time. The frequency of monitoring the drawdown after the first year is based on calculating the drawdown from the first year and ensuring that measurements are taken when the wetland depth of inundation at the maximum depth, half the maximum depth and right before the wetland is dry. The Technical Standard for Wetland Hydrology was met if wetland hydrology occurred in at least 50 percent of years (i.e., ≥5 years in 10) (EPA, 2005).

2) Performing a topographic survey based on NAVD 88 and the horizontal coordinates are based on NAD83 (2007) LEICA RTK-MAX Northern California Network. The survey must tie into the existing topographic data of the site. Two perpendicular transects at minimum shall be taken within each wetland. The surveys should occur at minimum every 3 years or when significant erosion or accretion has occurred in the wetland. The provided survey data points shall be in 0.01' accuracy.

Soils will be evaluated annually in each the wetland on the Upper Boat Ramp Fountain Thistle site. One hole per wetland cell will be evaluated to a depth of 15 inches.

Data from the soil moisture meters will be collected with data loggers from February through June and will be plotted to view the trend of the soil moisture throughout the rainy season and as the reservoir levels change.

8.2 Vegetation Monitoring Methods

8.2.1 Permanent Photo Documentation Points

Permanent photo documentation points will be established within the project area prior to construction. A minimum of 2 photo documentation points per project area will be established to document site conditions. The location of the photo documentation site will be GPS'd to

facilitate relocation and a GIS map of the location created as part of the first monitoring report. The photo documentation points should include landscape features that are unlikely to change over several years (buildings, other structures, and landscape features such as peaks, rock outcrops, large trees, etc.) so that repeat photos will be easy to position. The placement of a permanent T-post or metal fence post marking the photo points will improve consistency between years (State Water Resources Control Board 2010).

Photos will be taken from these photo documentation points at the same camera angle each monitoring year, using a north, south, east, west compass bearing axis at the selected photo points, as appropriate to illustrate site conditions.

Photographs will be taken from approximately 5 ft in height, with exact height recorded using a standardized tripod or rod to ensure consistency of height from year to year.

In addition to the permanent photo stations, photographs will also be taken from the origin of each vegetation monitoring transect looking north, south, east, and west. In Years 5 and 10, vegetation cover will be assessed using aerial photos if available to supplement other data collection methods.

8.2.2 Vegetation Monitoring

Vegetation monitoring will be performed using a statistically robust method known as power analysis to assess tree survivorship and percent cover of native and invasive perennial forbs, grasses, and shrubs. Power analysis would measure percent survivorship to within a margin of error of 10% at the 95% confidence interval (i.e., assesses percent survivorship to within +/- 10% of the true value, with a 95% likelihood of covering the true value in that range). The proposed power analysis method includes:

- Development of a monitoring protocol describing data collection techniques;
- Sub-sampling across different planting areas, sites and habitats; and

The proposed method would minimize the data collection effort while meeting requirements for statistical rigor.

Vegetation monitoring will be conducted during Years 1-5 for hydroseeded grassland, and planted or established wetland, and willow riparian communities and in Years 1-5, 7, 9 and 10 for tree dominated communities. The point-line intercept method will be used to estimate total vegetative cover, native cover, hydrophytic cover, and non-native invasive cover. A count of planted hardwood trees within 100 m^2 plots will be used to estimate tree survival. These methods will be used to determine whether mitigation areas are meeting set success criteria for vegetative cover.

Power analysis. An *a priori* power analysis will be used to determine the monitoring effort required for the statistical analysis. The design of the statistical analysis influences the power analysis, including: specific question to be answered and related statistical parameters; in this case, the allowable margins of error and confidence intervals. We define the specific question to be addressed as follows:

Is the true value of the percent cover less than or equal to the percent cover requirement?

The allowable certainty for percent cover will be a margin of error of +/- 10% at the 95% confidence interval. The confidence interval is the probability that the true value would be encapsulated in the margin of error around the reported percentage; the lower the confidence interval, the smaller the margin of error. Margin of error (ME), confidence interval and required number of sampling points (n) are related by the following equation for the 95 % confidence interval:

$$ME = 0.98/\mathrm{sqrt}(n)$$

The number of sampling points required to evaluate percent cover will be calculated using this equation. However, the following factors will be considered in estimating the number of sampling plots to estimate survivorship:

- The specific monitoring targets (e.g., such as whether survival of some planted species can be pooled resulting in fewer sampling points or must be examined separately by species),
- The number of trees to be planted and number of different planting areas.

Monitoring Protocol and Analysis for Estimating Hardwood Tree Survival: Data collection for survivorship for planted hardwood trees (primarily oaks) will require a biologist to determine if a given plant is alive or dead at a given number of flagged planting sites in an area (sampling plot).

Sampling plots will be used to conduct survivorship surveys. These plots will be randomly established each year based on a grid overlay of the entire mitigation area. Using GIS, a 10-meter by 10-meter grid will be overlaid on all mitigation areas. Each vertex of that grid will be labeled with a number. Using a random number generator, vertices will be selected to serve as the center of square sampling plots and transects. Once the vertices have been selected, locations will be identified in the field using a GPS device. Biologists will navigate to the coordinates specified by the GPS and establish a center point. From this center point, 2 10-meter transect tapes will be extended, 5 meters in each cardinal direction; the center point will be located at the 5-meter mark for both cross-transects. In each 10 meter by 10 meter plot, each live tree will be counted and species will be recorded. In addition, observations regarding tree health (e.g., premature leaf loss, evidence of dieback shoots, severe insect infestation) will be noted, particularly when poor health is an apparent indicator of imminent mortality.

The number of sampling plots depends on the vegetation community, final number of hardwood trees to be planted, number and size of planting areas, data collection method and spacing of plantings. Data must be collected at 3 or more sampling plots to allow for statistical analysis. Since some habitat types (e.g., riparian habitats) are being established/reestablished or rehabilitated in very narrow bands, it is possible that the $100m^2$ plots, will not fall entirely within a single habitat type. If this occurs the plots can be shifted such so the entire plot is in a single habitat type.

A t-test will be used to evaluate whether or not percent survivorship is less than or equal to the interim or final success criteria.

Survivorship trends will be analyzed after collecting 3 years of data, the minimum required to plot a line. Percent survival mean and 95% confidence interval will be plotted against time along with the minimum allowable percent survival. An analysis of trends in survivorship will evaluate if the survivorship decline rate over time is significantly different than zero. Without replanting

or recruitment, survivorship will decline over time, likely modeled as exponential, ideally, flattening over time.

Monitoring Protocol and Analysis for Estimating Vegetative Cover: Point-line intercept surveys will be used to estimate absolute vegetative cover, native cover, and hydrophytic cover in grasslands, wetlands, and willow riparian habitats. Point-line intercept surveys will also be used to estimate non-native invasive species cover in all habitats. The number of sampling points would be determined using the power analysis method above[2].

Data will be collected along randomly located transects at points established by placing a 2-meter metal rod vertically (perpendicular to the ground) at defined intervals (1 or 5 meters) along a transect tape. The plant species touching the rod within each height category (low, medium, and high) will be recorded. Plant species that touch the rod in more than one height category will be recorded in each height category. The 2 smallest vegetation height categories, Low (0.0 meter to 0.5 meter) and Medium (0.5 meter to 2 meters), are captured by the height of the rod (2 meters tall). The High category (over 2 meters) will be estimated using eyesight. In addition to vegetative cover, each point where there is no vegetation, bare ground will be noted.

A t-test will be used to evaluate whether or not percent cover is less than or equal to the interim or final success criteria. Trend analysis may be more informative than examining threshold exceedance because invasive species percent cover increases often are predictive of long-term ecological composition. Trend analysis would be conducted as described for tree survivorship with the caveat that annual climatic variation may influence the percent cover.

Non-native Invasive Plant Monitoring: During spring or early summer of Years 1-5, and for tree dominated communities in Years 7, 9 and 10, non-native invasive plant cover will be calculated from the point intercept data collected from all sites, as described above. In addition to this monitoring, areas with greater than 5 percent cover of target non-native species will be mapped using GPS as long as areas are safely accessible. Maintenance activities to control non-native invasive species will be targeted in these areas. Each year the acreage of mapped highly invasive species will be compared.

A spring inspection in subsequent years comparing mapped non-native invasive cover from the prior year will be conducted to determine if a non-native invasive species population has spread or a new species has invaded. In either scenario, maintenance activities may be required.

8.2.3 General Site Assessments

Qualitative data will also be collected each year of monitoring for the purpose of informing management. These general site assessments are intended to assess the overall functioning of the site as a whole, and also to help identify localized or low-level trends such as new invasive species formations, localized changes in species abundance, and other changes that might be important to address through remedial management actions.

The following data will be collected during the site assessment:

[2] Note that a margin of error will increase the uncertainty around the percent cover of invasive species. The threshold for invasive species 5% cover, however, a value of 4% could represent a value of 0 to 9% cover of invasive species (at the 95% confidence interval). Reducing the margin of error requires increasing the sampling effort, and margins of error within 1% would require prohibitively intensive sampling efforts.

- Mortality (presence/absence) of planted trees.
- Species richness. This general site data will be used for calibrating similar data taken at transects, but is not intended for comparison with success criteria. Data will also help to evaluate whether invasive or non-native species are out-competing native plants, and whether more active management might be required.
- A visual assessment of cover in planted and hydroseeded areas, invasive species over the entire site, and related observations of vegetation and habitat condition.
- Other site characteristics, including patterns of plant die-offs, erosion, hydrological issues, trespass, herbivory or pressure, or other land use issues. This information is intended for use in recommending management actions as necessary

Table 14. Qualitative Score for Assessing the Health and Vigor of Planted Stock

SCORE	DESCRIPTION OF SCORE
Excellent	No evidence of stress; minor pest or pathogen damage may be present. No chlorotic leaves, no or very minor herbivory (browse). Evidence of new growth, flowering, seed set on majority (greater than 75 %) of plants observed.
Good	Some evidence of stress. Pest or pathogen damage present, few chlorotic leaves (> 5%), minor evidence of herbivory (browse). Evidence of new growth, flowering, seed set on most (greater than 50%) of plants observed.
Fair	Moderate level of stress; high levels of pest or pathogen damage, some chlorotic leaves (> 10%), some herbivory damage (few snapped leaves, stems, wear mamrks etc.). Evidence of new growth, flowering, seed set on some (less than 50%) of plants observed.
Poor	High level of stress; high levels of pest or pathogen damage, many chlorotic leaves (> 30%), severe herbivory damage (massive forage damage, main stems/leaves stripped etc.). No evidence of new growth, flowering, or seed set, or only a few plants (less than 25%) with these characteristics.

Fountain Thistle and Crystal Springs Lessingia Monitoring**:**

Annual total census counts are not recommended at the Boat Ramp Fountain Thistle site in the area of rare plants because fountain thistle forms a dense monotypic stand; access unavoidably involves trampling of fountain thistle plants. Instead, fountain thistle will be surveyed annually using sample quadrats. Quadrats will be selected and surveyed using methodology similar to that described in the HT Harvey & Associates SFPUC Winter 2010 Fountain Thistle Survey Report. The number of quadrats, quadrat size, and optimal stratification will be initially determined during the first year of surveys by comparing results from the quadrat method to a full census count taken during the same year. Quadrats will cover a minimum of 2% of the total occurrence.

A life cycle study will help identify potential competition and determine if the population is expanding or stable. Relative abundance of different life history stages (i.e., seedling, rosette, bloom) in the fountain thistle study plots will be counted at different times of year.

8.2.3 General Wildlife Use

A general wildlife use assessment will be conducted once per year for the entire monitoring period of five years to document common wildlife, songbird, and raptor use of the site. Data are

intended to help assess overall site functioning and not as a performance measure. Annual monitoring will be conducted for the San Francisco garter snake and the California red legged frog special status species. Day and night (half hour before sunset) surveys will occur 2-4 times per year and is to be performed by a qualified biologist.

- Surveys will be conducted between March- June
- Survey will be conducted at the wetland
- Document habitat conditions
- Document occurrence or absence of prey (for snakes)
- Depth of pond (Dmax)
- Water availability to support the CRLF
- Water temperature (near surface and at Dmax)
- Percent cover of emergent vegetation
- Occurrence of SFGS & CRLF using visual, auditory, dipnet, egg mases, and/or larval surveys
- Occurrence of additional amphibian species (adults, juveniles and larvae)
- Occurrence of predators including snakes, birds, bullfrogs, and fish (native predators do not reflect poorly on restored habitat

8.3 Monitoring Schedule

Generally, grassland and wetland communities will be monitored from March through May, and woodland or riparian communities in late September or early October. Some flexibility to account for annual variation in weather conditions is acceptable.

Monitoring of vegetation will be completed during the performance period as described below. After the performance period (typically five years for understory), the site will be inspected for general parameters including observations of invasive non-native plants or trees, signs of erosion or vandalism.

Monitoring for fountain thistle will occur each year through the monitoring period, or as negotiated with USFWS and CDFG. Methods will follow those used by H. T. Harvey (2010) for baseline surveys.

Table 15 Boat Ramp Mitigation Monitoring Schedule

Task	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Permanent Photo-monitoring			*	*								
Hydrology Monitoring		*	*	*	*	*	*	*				
Vegetation Monitoring- includes special status plants species				*		*				*		*
Invasive Species(listed target plants) Monitoring	*		*		*		*		*	*		
Wildlife Monitoring[*]			*	*	*	*						
Monitoring report												*

*Includes target species (aquatic, MB butterfly, and vegetation); * only needed if occurrence was not recorded for the CRLF

9.0 MAINTENANCE DURING MONITORING PERIOD

9.1 Processes

The community types present at the Boat Ramp sites provide habitat for sensitive as well as more common species. Reestablished and enhanced habitats have been designed to be as self-sustaining as possible. However, natural ecosystems are dynamic and subject to change over time. This is especially true in modern fragmented urban preserves, where the vast landscapes and ecological processes which once maintained a habitat mosaic may have been partially or completely disrupted. Natural processes include flood and drought, fog, fire, wind, disturbance by burrowing animals, and grazing.

As a result of human-induced change, management is usually required to maintain preserves and prevent gradual degradation. In the short term, management will likely be necessary to minimize resprouting of aggressive native species such as coyote brush and poison oak in grassland areas. The following discussion identifies approaches to longer term maintenance after the end of the construction and planting period.

Year 1- In early March or late February, natives should be establishing while weeds are going to be emerging. Plants like yellow star thistle can compete for light, are top heavy and can shade out newly germinated natives. For the first year after seeding has commenced a few management options are available and again it is stressed that multiple options yield the most benefits such as mowing, hand pulling (in high sensitive areas such as zone one of the fountain thistle areas and within the wetland) and herbicide application including the wicking method. Broadleaf herbicide application is best when weeds are small in February to mid March. The newly seeded perennial plants should be past the three leaf stage before spraying or wicking with an herbicide such as glyphosate. Another option may be impazapyr, which is being currently tested on controlled pilot plots on jubata grass on SFPUC lands in their herbicide resistance management program.

In consideration of the SFGS, blade height of 3-4 inches is suggested and avoidance of peak activity is best. Mowing in late February through April has been successful in coastal areas (Anderson, 2001). A second summer mowing in June or late spring helps to provide light to the young perennials and reduces the height of non-natives. The combination of mowing and herbicide has good results for controlling late season weeds. July is also a good time to mow established grasses and avoids the bird nesting season (Anderson, 2010).

Second year follow-up- Annual weeds are long lived in the seedbank and will be problematic for at least 3-6 years where ongoing maintenance should be expected despite thorough following initial pre-planting weed eliminating procedures. Pre and post emergent herbicides, mowing, grazing and fire are the recommended strategies for continued invasive species management and control. Pre-emergent herbicide can greatly reduce this next round of undesired plant establishment when applied in the fall. This will not adversely affect the first year of native grasses that have become established. Back pack sprayers that hold up to 4 gallons of herbicide can be cost effective and cover large areas of invasive patches while avoiding the relatively sensitive newly established first year natives. Spot spraying is an alternative to the backpack application for warm season perennials (Anderson, 2001). If populations are small or outliers are

identified, it may be feasible to hand pull undesired plants, or in areas of high sensitivity such as the fountain thistle enhancement and wetland area.

9.2 Inspection Activities and Frequencies

The following inspections will be generally performed on an annual basis at the time of mitigation monitoring. Field notes will document whether conditions are normal or abnormal, and the annual monitoring report will recommend remedial actions to address any significant issues, as deemed necessary. The annual monitoring should note whether within each habitat type, the following conditions are observed:

1. Is erosion control in place and functioning properly?
2. Are planting areas exhibiting excessive water or drought stress (too much or too little water as evidenced by leaf wilt, leaf drop, plant die off, etc.), as described in Table 11?
3. Is there any presence of new or reestablished populations of invasive plants? Pioneer populations of invasive plants (previously unidentified at the site, such as fennel, pampas grass, etc.) should be treated immediately upon detection. Existing invasive plant populations (as listed in Section 6), or others, are to be managed under an adaptive management plan if reestablishment or continued predominance is detected.
4. Is there a distinctive pattern of plant die off (i.e., all species of a single plant or a cluster of plants within a small area)?
5. Are the fountain thistle or other rare plant populations expanding, stable, or decreasing?

9.3 Remedial Actions (Adaptive Management)

While initial efforts are important, living systems require ongoing maintenance and management. We recommend an adaptive management strategy for maintaining and managing the site.

Adaptive management is a tool used to cope with the inherent changes and instability fundamental to natural resources and the ecological processes that encompass them. It is a process derived from a collection of practical methods based in research and monitoring. As a philosophy, it holds that conservation and restoration programs should be designed in ways that accumulate knowledge as quickly and accurately as possible so that the management plan can be adapted promptly to better management efforts. This approach allows managers to learn by experience within site specific environments and apply lessons learned to remedy deficiencies using a controlled and scientific approach.

Monitoring and maintenance will respond with adaptive management procedures, recommended on a case-by-case basis, to address any issues identified at the site. Remedial actions could include one or more of the following activities (not exclusive):

1. Weeding around planting sites to reduce competition from non-native grasses and forbs;
2. Supplemental watering;
3. Additional erosion control;
4. Additional invasive plant control;
5. Supplemental replacement plantings (may be in-kind, or if a particular species is not doing well at the site, a suitable replacement species can be supplemented for original plant species);
6. Hydrologic modification or minor regarding

7. A report documenting the presence of replacement plants will be provided to USFWS/CDFG prior to incremental inundation.

9.3.1 Initiating Procedures

Standards for when to implement remediation will be if the percent cover in any monitoring year (averaged over sample plots) is 15% below the target level described under "Annual Success Criteria," or if final criteria are not met. The hydrologic triggers that will dictate remedial actions are water quantity, erosion, and sedimentation; once again, remediation will occur if monitoring documents results 15% below the success criteria. If annual performance criterion are not met, a report shall be prepared analyzing the cause of failure and, if necessary, proposing remedial action for agency approval.

9.3.2 Replanting

Replanting would be recommended if it is deemed that no other procedure could be employed to restore the target habitat to meet monitoring criteria if there is a lack of survival from targeted planting efforts.

- Replanting may be deemed appropriate during the 6 month installation warranty period to replace dead plants. Plants should be replaced during the next rainy season. This should be considered throughout the monitoring period, considering the 6 month window may not include potential casualties during the dry season.

- Replanting will also be incorporated if success criteria are not being met to remedy the loss of live plant stems. There is potential to change the plant palette if a lack of diversity has occurred.

- If a target species has poor success throughout the site it may be replaced with a new species of botanical significance to the restoration habitats.

- The reservoir will not be allowed to increase until the relevant stage of the compensation requirements for fountain thistle have been met.

- Fountain thistle or Crystal Springs lessingia seeding (using seed collected from various subpopulations to ensure genetic viability), transplanting and potentially translocation rare plants may be a viable option to ensure populations are sustainable.

There is potential to increase the amount of special status plant species in a follow-up planting plan for year two. Currently, viable plant stock is not available and seeds will need to be collected this fall to be propagated if they are desired to be planted in year 2 after construction has been completed.

The Boat Ramp site has moderate potential for the following special status plant species to occur once the site is restored: Franciscan onion *(Allium peninsulare var. franciscanum)*, San Francisco collinsia *(Collinsia multicolor),* Western leatherwood (*Dirca occidentalis*), Choris's popcorn flower (*Plagiobothy's chorisianus var. chorisianus*), bristly sedge (Carex comosa), San Mateo wooly sunflower, Crystal Springs lessingia, fragrant fritillary, and San Mateo thornmint (*Acanthomintha duttonii).* The nurseries should be selected well in advance so that adequate quantities and sizes of species will be available at time of planting.

9.3.3 Regrading

Regrading could be recommended if it is deemed that no other procedure could be employed to restore the target habitat to meet monitoring criteria.

9.3.4 Hydrologic Modification

Culvert and/or road height adjacent to the created wetland could be modified.

9.4 Invasive Species Control

9.4.1 Herbivory

Deer are a concern for browsing on the plantings. Stakes and mulch collars are recommended for planting to protect trees (if any) during establishment. Six-foot high metal deer fencing attached to metal posts could be used to protect the trees during establishment. However, herbivory is a natural component of portions of the ecosystem. For example, San Francisco dusky footed woodrat and western harvest mice have been observed within and immediately adjacent to the fountain thistle stand.

Predator control actions will be evaluated via monitoring and reviewed for efficacy. In the event that predator control fails to meet success criteria, contingency measures include:

- Draining wetlands to ensure the lifecycle for the bullfrog will not be met; if they are not self performing to dry out as intended they will be redesigned.

- If rodents are severely impacting the success criteria of planted material there may be a need to increase the timing of occurrence of removing the dense ground cover adjacent to the planted material. If deemed appropriate it may necessary to replant rooted specimens with a different tree protection measures.

9.4.2 Vegetation

Section 6 presents weedy/non-native and invasive species that are known to occur at the site, as well as management strategies to be employed to eliminate these species, as feasible.

Mowers can be used as needed and with procedures in place to prevent harm to sensitive animal species, to weed around the serpentine bunchgrass and invasive species management areas, while precautions should be made in the fountain thistle high sensitivity area (Zone 1) and wetland mitigation site. Machinery should not be used at the site during wet conditions.

An early detection rapid response mechanism should be in place for weed management throughout the year. Stakes and mulch collars will help to keep the weeds and mowers away from planted stock. Hand removal of weeds using a hoe to scrape the surface is adequate if this is done in the spring, there will be are reduction of annual grass seeds in the soil (McCreary, 2009). Reducing non-native annuals and invasive plants should occur throughout the year if needed.

Invasive species control will likely require repeated effort for at least several years and possibly throughout the monitoring period. Specific needs will be identified based on each year of monitoring, and documented in annual reports. Appropriate control methods will be utilized depending on the species, the abundance and distribution of the species, and the location within the site and relative to wetlands or other sensitive resources. Adaptive management is emphasized wherein various strategies will be employed, as presented in Section 6.0 depending

on site-specific conditions and invasive species issues at the time of management/maintenance activity. Tu et al. (2001) and other publications on invasive species control may be referenced when identifying appropriate methods for use within a habitat enhancement site.

Adaptive management can include non-chemical applications where the area around the trees can be mulched, or use of a black shade mat to increase survivorship of new plantings. Periodic grazing in the spring and late summer, mowing and propane torch flaming for residual brooms, poison oaks, and coyote brush can be implemented as post activity management techniques.

Post emergent application should still be considered after plant installations if deemed appropriate.

9.5 Maintenance Schedule

Maintenance will be conducted annually, during the dry season unless another time of year is more appropriate to avoid disturbance to sensitive species, habitats, or resources. Weed management (such as with a mower) should be done throughout the year. By implementing the frequent qualitative monitoring method of early detection, rapid response management for invasive plant species can be the key to ensuring they do not inhibit the success of rare plants and sensitive habitats by proliferating on this project site. If timing of maintenance needs to be modified for certain items, the rationale for the decision will be documented in annual reports. The schedule for maintenance during the monitoring period is shown in Table 17.

Table 16. Maintenance Schedule during the Monitoring Period

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Revegetation Inspection and Maintenance			I	I			I					M
Invasive Plant Inspection and Maintenance	I,M		I,M	I,M	I,M		I,M		I,M	I,M		
Predator Inspection and Maintenance *				I		I			I			
Hydrology Inspection and Maintenance					I						I,M	

I = Inspection, M = Maintenance

*Predators (bullfrogs, fish) are not expected to be a significant issue in the seasonal wetlands of the Adobe Grasslands site. Management will occur only if inspections identify an issue.

10.0 MONITORING REPORTS

10.1 As-Builts

At completion of site grading and planting, as-built drawings will be prepared and provided to appropriate agencies. Drawings will show, at a minimum, post-grading surface contours, typical cross-sections, and limits of each habitat or planting zone. The Water Board shall be notified that mitigation construction and planting has been completed within 72 hours of concluding these activities.

10.2 Annual Reports

Annual reports of monitoring results will be submitted to the U.S. Army Corps of Engineers, San Francisco District, and the Bay Area Regional Water Quality Control Board, California Department of Fish and Game, and U.S. Fish and Wildlife Service. Once the planting efforts are completed, the Water Quality Control Board would be contacted within five (5) days. The reports will assess attainment of yearly target criteria and progress toward final success criteria. If final success criteria are met early, then a request for early completion of permit requirements will be made. Photographs of restoration areas shall be included in annual reports, as necessary, to document site conditions.

10.3 Due Dates

As-builts will be provided within 120 days after the completion of construction and planting activities. The Bay Area Regional Water Quality Control Board would be notified within 5 days after revegetation activities are completes. The first annual report shall be delivered by December 31 of the year following the first growing season after planting, with a report provided by December 31 of each subsequent year until the end of the 5-year monitoring period.

11.0 CONTINGENCY MEASURES

11.1 Initiating Procedures

If an annual performance criterion (averaged over sample plots) is not met for any year, or if final criteria are not met, a report shall be prepared analyzing the cause of failure and, if necessary, proposing remedial action for approval. Potential remedial actions include but are not limited to replanting, modifying management strategies or methods, providing additional offsite mitigation or extending the monitoring period.

11.2 Contingency Funding Mechanism

SFPUC is responsible for funding any adaptive management or additional measures which it determines are necessary and with which the appropriate agencies concur. SFPUC will provide the agencies with a financial assurance memorandum of understanding as a standalone document.

12.0 COMPLETION OF MITIGATION RESPONSIBILITIES

12.1 Notification

When performance criteria have been met, the applicant will notify the San Francisco District of the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, the California Department of Fish and Game, and the Regional Water Quality Control Board. Documentation will be provided within the accompanying annual report.

12.2 Agency Confirmation

Upon notification of completion the agencies identified above may concur based on written documentation or, at their discretion, may request a site visit to observe the completed project.

13.0 LONG TERM MANAGEMENT

Long-term management will be required at the enhanced, re-established or established wetlands, riparian and grassland habitats. A Long Term Management Plan for all of the Peninsula HRP sites, including the sites described in this MMP will be prepared and submitted for agency review by December 2010. This Plan will provide information concerning ongoing management of these sites by SFPUC after the final success criteria described herein have been met. The Long Term Management Plan will define the goals and objectives for each habitat type and prescribe management actions to meet them. Activities that will be addressed in the Plan will include but not be limited to: invasive plant management (including native as well as non-native plants), invasive predator control, erosion and sedimentation, infrastructure management, and grazing. Monitoring, contingency measures, and schedules associated with these activities will also be addressed in the Plan. The Plan will also be of sufficient detail to feed into the PAR analysis and the development of the endowment for the conservation easement.

14.0 SITE PROTECTION

The Boat Ramp site is within the larger Peninsula holdings, which are protected by perimeter fencing and gates. Signs will be installed at site access points to educate authorized visitors about the sensitive nature of the habitat. Watershed keepers will patrol the access road and report any damage or other issue.

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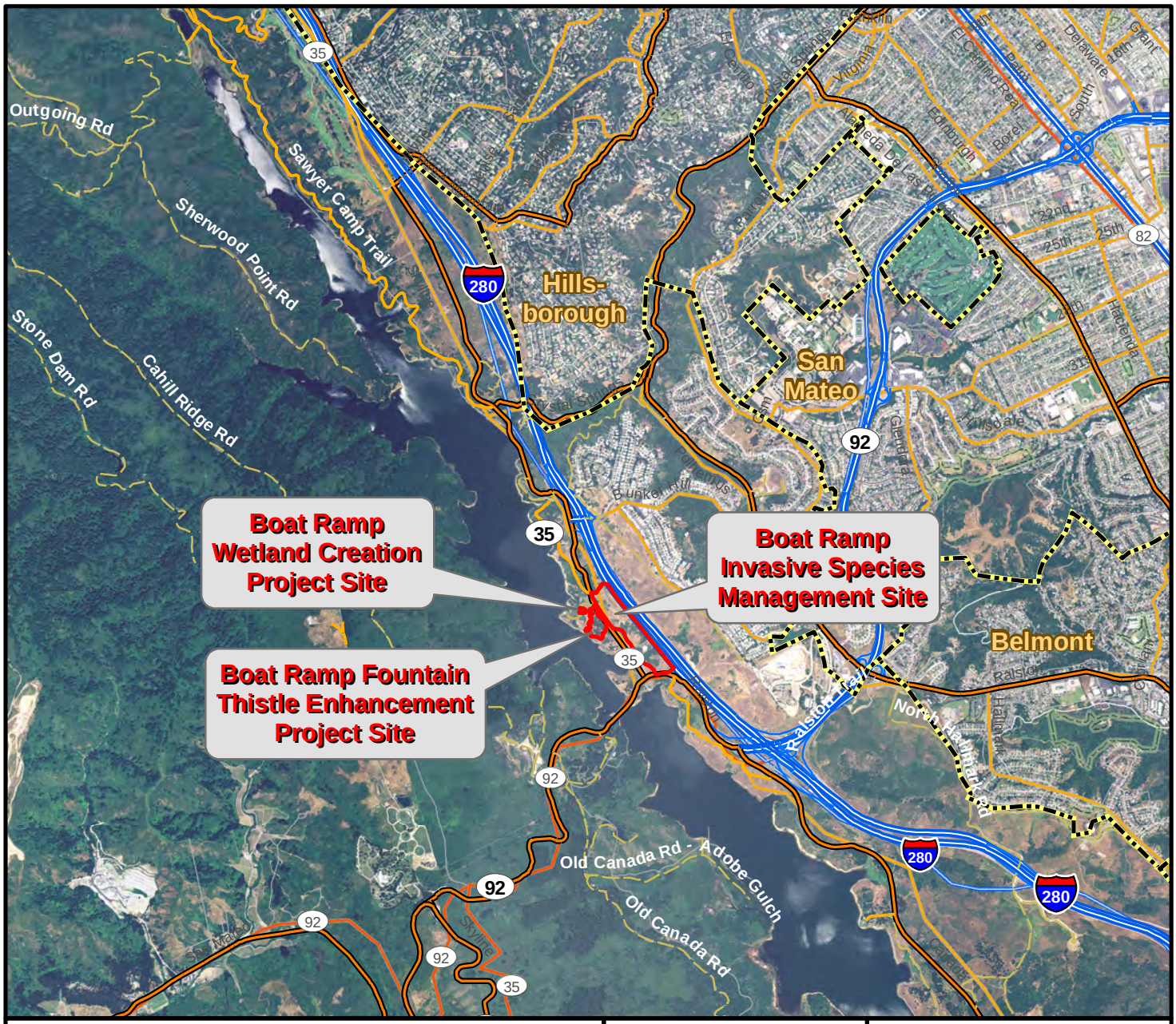
Appendix A
Figures



0 2,000 4,000 8,000 Feet

1 inch = 4,000 feet

Boat Ramp Project Sites

City Boundaries

Primary Highway

Secondary Highway

Roads on SFPUC land

Paved road

Unpaved road

Figure 1
Boat Ramp
Wetland Creation
Fountain Thistle Enhancement
Vicinity Map

Projection & Coordinate System:
California State Plane NAD 83 Ft Zone 3
Lambert Conformal Conic
GCS North American 1983
Datum: D North American 1983

N

San Francisco Public Utilities Commission
Habitat Restoration Projects

Cartographer	Date	Project #
GLD	7/23/10	1011410010

WINZLER & KELLY
633 3RD ST
EUREKA, CA 95521
P: 707-443-8326 F: 707-444-8330

0 200 400 800 Feet

1 inch = 400 feet

Boat Ramp Project Area

Extent of Figures 4 - 11

Figure 2
Boat Ramp Wetlands Creation and Fountain Thistle Restoration
Site Map

Projection & Coordinate System:
California State Plane NAD 83 Ft Zone 3
Lambert Conformal Conic
GCS North American 1983
Datum: D North American 1983

N

San Francisco Public Utilities Commission
Habitat Restoration Projects

Cartographer	Date	Project #
RCH/GLD	7/14/10	1011410010

WINZLER & KELLY
633 3RD ST
EUREKA, CA 95521
P: 707-443-8326 F: 707-444-8330

0 150 300 600 Feet

1 inch = 300 feet

Boat Ramp Project Area

Contours-Index 10Ft

Contours 2Ft

Figure 3
Boat Ramp Wetlands Creation and Fountain Thistle Restoration
Topography

Projection & Coordinate System:
California State Plane NAD 83 Ft Zone 3
Lambert Conformal Conic
GCS North American 1983
Datum: D North American 1983

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Habitat Restoration Projects

Cartographer	Date	Project #
GLD	7/14/10	1011410010

WINZLER & KELLY
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0 100 200 400 Feet

1 inch = 200 feet

Boat Ramp Project Areas

Paved Road

Delineated Wetlands

Other Waters

Figure 4
Boat Ramp Wetlands Creation and Fountain Thistle Restoration
Jursidictional Wetland Delineation

Projection & Coordinate System:
California State Plane NAD 83 Ft Zone 3
Lambert Conformal Conic
GCS North American 1983
Datum: D North American 1983

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Habitat Restoration Projects

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GLD	7/14/10	1011410010

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0 100 200 400 Feet

1 inch = 200 feet

- Seasonal Wetland
- Sediment Basin
- Seep
- Boat Ramp Project Area
- Intermittent Stream
- Contours-Index 10Ft

Figure 5
Boat Ramp Wetlands Creation and Fountain Thistle Restoration
Hydrologic Basemap

Projection & Coordinate System:
California State Plane NAD 83 Ft Zone 3
Lambert Conformal Conic
GCS North American 1983
Datum: D North American 1983

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Habitat Restoration Projects

Cartographer	Date	Project #
GLD	7/14/10	1011410010

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0 100 200 400 Feet

1 inch = 200 feet

Soil Pit

Contours-Index 10Ft

Boat Ramp Project Area

Figure 6
Boat Ramp Wetlands Creation and Fountain Thistle Restoration
Soil Sample Locations

Projection & Coordinate System:
California State Plane NAD 83 Ft Zone 3
Lambert Conformal Conic
GCS North American 1983
Datum: D North American 1983

N

San Francisco Public Utilities Commission
Habitat Restoration Projects

Cartographer	Date	Project #
GLD	7/14/10	1011410010

WINZLER & KELLY
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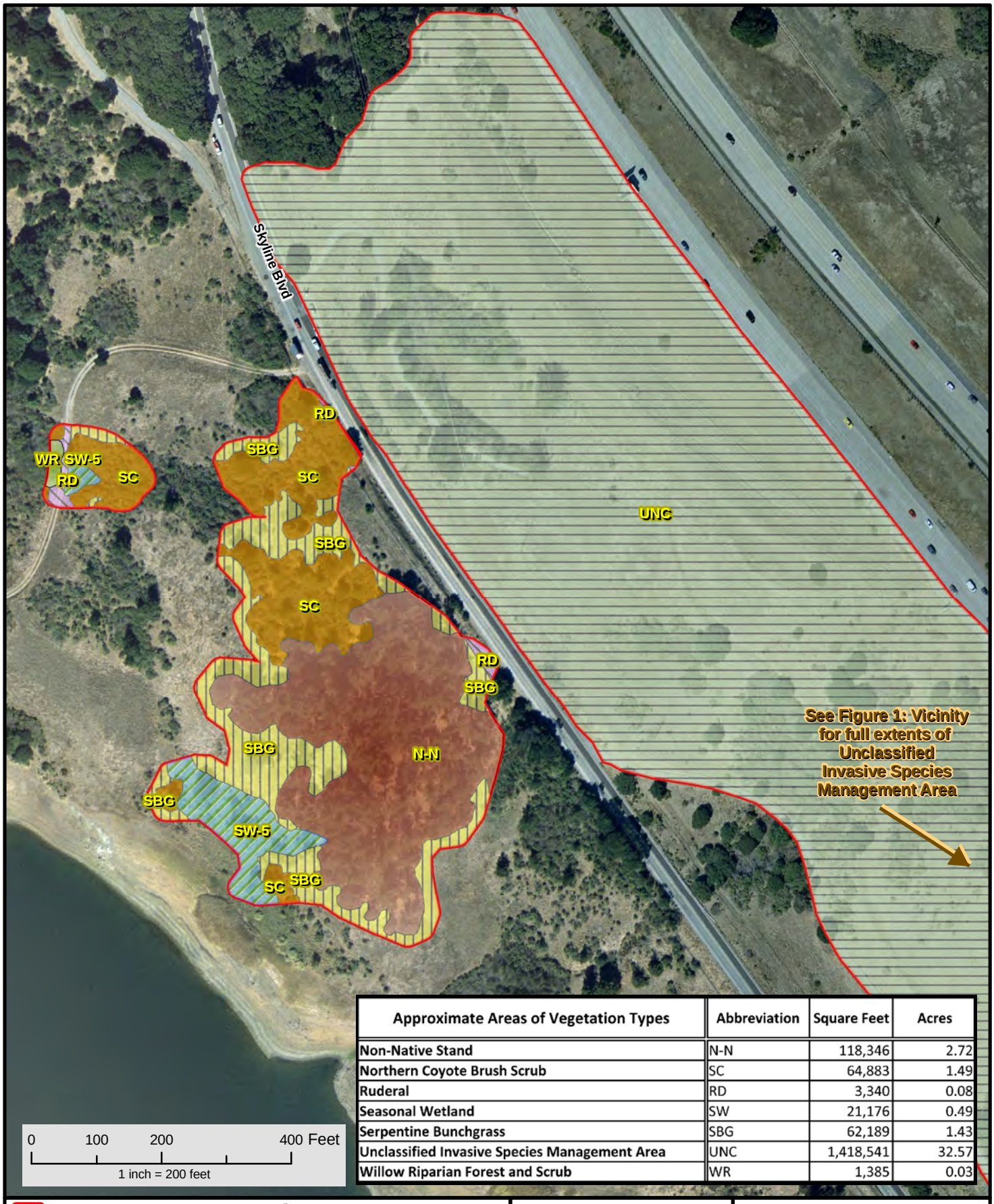

Approximate Areas of Vegetation Types	Abbreviation	Square Feet	Acres
Non-Native Stand	N-N	118,346	2.72
Northern Coyote Brush Scrub	SC	64,883	1.49
Ruderal	RD	3,340	0.08
Seasonal Wetland	SW	21,176	0.49
Serpentine Bunchgrass	SBG	62,189	1.43
Unclassified Invasive Species Management Area	UNC	1,418,541	32.57
Willow Riparian Forest and Scrub	WR	1,385	0.03

- Boat Ramp Project Areas
- Non-Native Stand (N-N)
- Northern Coyote Brush Scrub (SC)
- Ruderal (RD)
- Serpentine Bunchgrass (SBG)
- Seasonal Wetland (SW)
- Unclassified Invasive Species Management Area (UNC)
- Willow Riparian Forest and Scrub (WR)

Figure 7
Boat Ramp Wetlands Creation and Fountain Thistle Restoration
Vegetation Classification
Existing Conditions

Projection & Coordinate System:
California State Plane NAD 83 Ft Zone 3
Lambert Conformal Conic
GCS North American 1983
Datum: D North American 1983

N

San Francisco Public Utilities Commission
Habitat Restoration Projects

Cartographer	Date	Project #
RCH/GLD	7/14/10	1011410010

WINZLER & KELLY
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EUREKA, CA 95521
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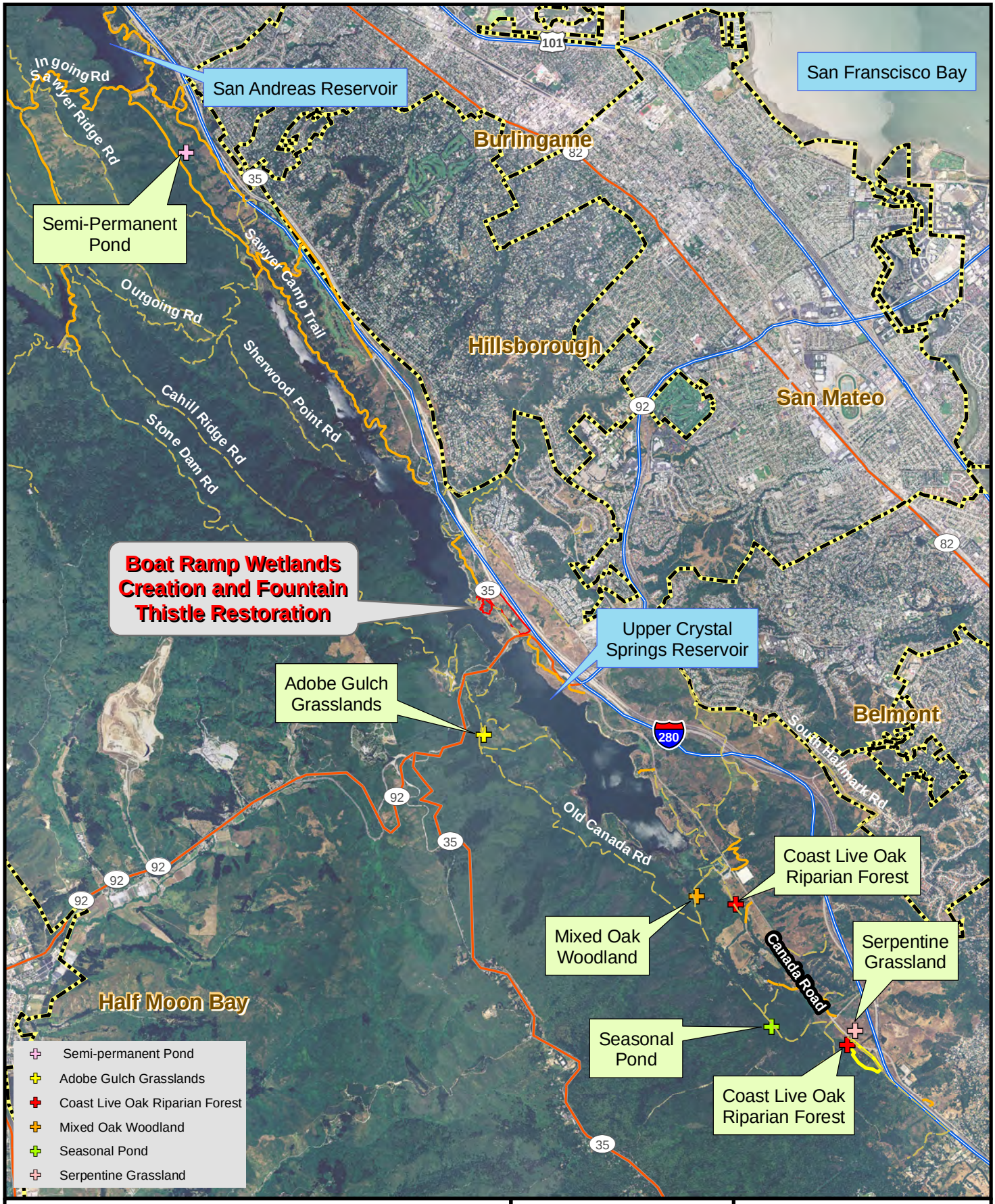


0 3,000 6,000 12,000 Ft

1 inch = 6,000 feet

Adobe Gulch

City Boundaries

Primary Highway

Secondary Highway

Roads on SFPUC land

Paved road

Unpaved road

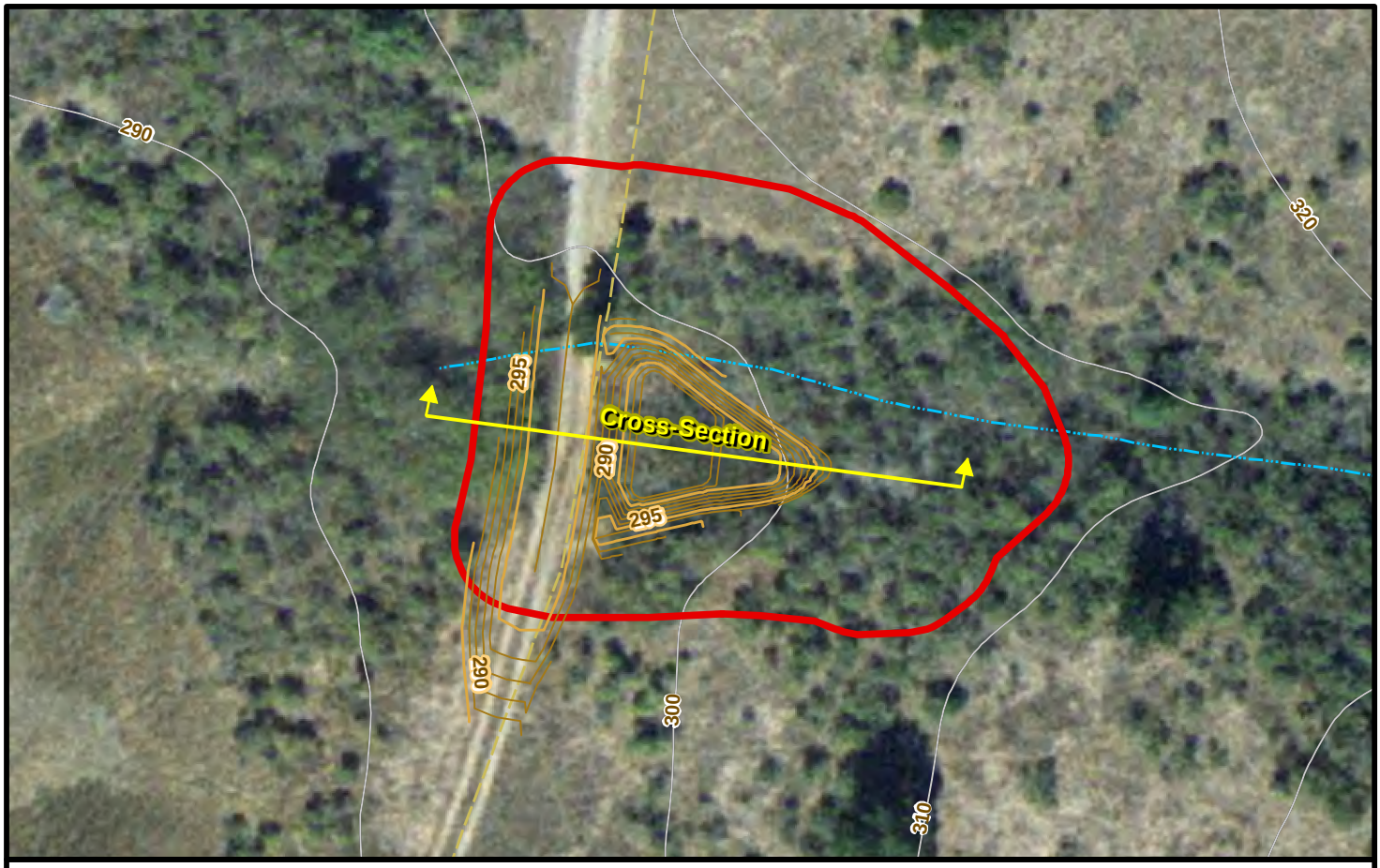
Figure 8
Boat Ramp Wetlands Creation and Fountain Thistle Restoration
Reference Site Locations

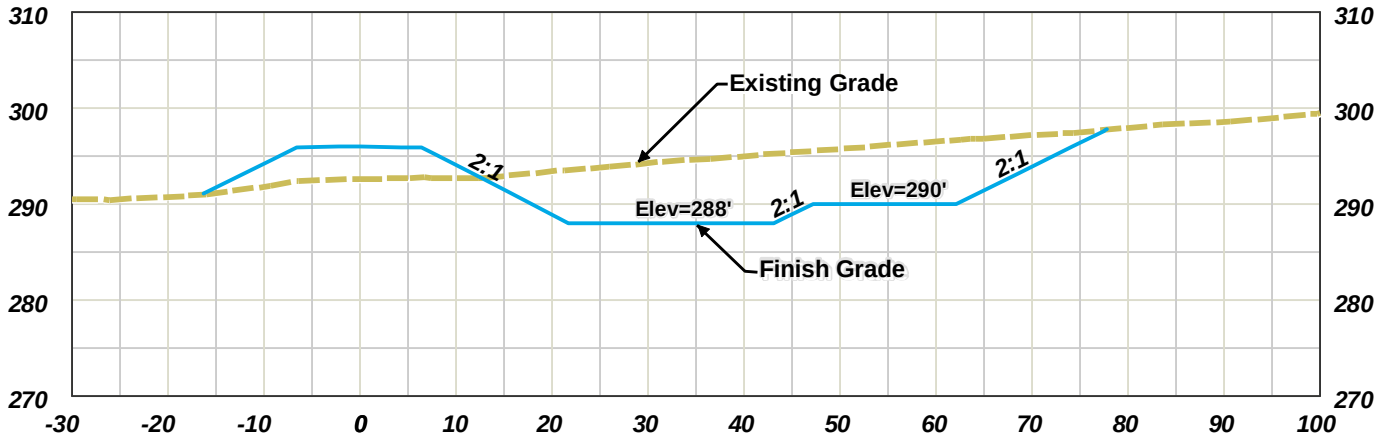
Projection & Coordinate System:
California State Plane NAD 83 Ft Zone 3
Lambert Conformal Conic
GCS North American 1983
Datum: D North American 1983

San Francisco Public Utilities Commission
Habitat Restoration Projects

Cartographer	Date	Project #
GLD/RCH	7/14/10	1011410010

WINZLER & KELLY
633 3RD ST
EUREKA, CA 95521
P: 707-443-8326 F: 707-444-8330





0 25 50 100 Feet

1 inch = 50 feet

Project Limits

Existing Contours 10-ft

Grading Limits

Wetland Boundary

Berm Boundary

Proposed Grading Plan

Index Contours 5-ft

Contours 1-ft

Finish Grade

Figure 9
Boat Ramp Wetlands Creation and Fountain Thistle Restoration Grading Plan

Projection & Coordinate System:
California State Plane NAD 83 Ft Zone 3
Lambert Conformal Conic
GCS North American 1983
Datum: D North American 1983

N

San Francisco Public Utilities Commission
Habitat Restoration Projects

Cartographer	Date	Project #
GLD	7/14/10	1011410010

WINZLER & KELLY
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Tree Removal Zone Types	Sensitivity	Square Feet	Acres
Pulley System Zone	High	54,183	1.24
Bucket Truck/Crane System Zone	Moderate	45,992	1.06
Conventional System Zone	Low	153,848	3.53

Boat Ramp Project Areas

Pulley System Zone (High Sensitivity) - 1.24 acres

Bucket Truck/Crane System Zone (Moderate Sensitivity) - 1.06 acres

Convential System Zone (Low Sensitivity) - 3.53 acres

Figure 10
Boat Ramp Site
Tree Removal Zones

Projection & Coordinate System:
California State Plane NAD 83 Ft Zone 3
Lambert Conformal Conic
GCS North American 1983
Datum: D North American 1983

N

San Franscisco Public Utilities Commission
Habitat Restoration Projects

Cartographer	Date	Project #
RCH/GLD	7/24/10	1011410010

WINZLER & KELLY
633 3RD ST
EUREKA, CA 95521
P: 707-443-8326 F: 707-444-8330

0 100 200 400 Feet

1 inch = 200 feet

Boat Ramp Project Area

Year 1 - Serpentine Bunchgrass

Year 2 - Serpentine Bunchgrass with Seep Inclusion

Wetland Enhancement

Erosion Control

Figure 11
Boat Ramp Wetlands Creation and Fountain Thistle Restoration
Planting Plan

Projection & Coordinate System:
California State Plane NAD 83 Ft Zone 3
Lambert Conformal Conic
GCS North American 1983
Datum: D North American 1983

N

San Franscisco Public Utilities Commission
Habitat Restoration Projects

Cartographer	Date	Project #
RCH	7/14/10	1011410010

WINZLER & KELLY
633 3RD ST
EUREKA, CA 95521
P: 707-443-8326 F: 707-444-8330

Appendix B
Site Photographs

Fountain thistle (*Cirsium fontinale* var. *fontinale*) and tufted hairgrass (*Deschampsia caespitosa*) near Monterey pine stand.

Interior of Monterey pine stand

Existing seasonal wetland at Boat Ramp access road. Note the culvert and the lone oak.

Appendix C
Soils

A & L WESTERN AGRICULTURAL LABORATORIES

1311 WOODLAND AVE #1 | MODESTO, CALIFORNIA 95351 | (209) 529-4080 | FAX (209) 529-4736

REPORT NUMBER: 09-334-021

CLIENT NO: 2664-D

SEND TO: WINZLER & KELLY ENGINEERS
633 THIRD STREET
EUREKA, CA 95503-

SUBMITTED BY: LIA WEBB

GROWER: REF#10114-09009-33035

DATE OF REPORT: 12/07/09

SOIL ANALYSIS REPORT

SAMPLE ID	LAB NUMBER	Organic Matter		Phosphorus		Potassium	Magnesium	Calcium	Sodium	pH		Hydrogen	Cation Exchange Capacity	PERCENT CATION SATURATION (COMPUTED)				
		* % Rating	** ENR lbs/A	P1 (Weak Bray) **** * ppm	$NaHCO_3$-P (OlsenMethod) **** * ppm	K ***** * ppm	Mg *** * ppm	Ca *** * ppm	Na *** * ppm	Soil pH	Buffer Index	H meq/100g	C.E.C. meq/100g	K %	Mg %	Ca %	H %	Na %
SP-10	54199	4.1H	112	6VL	7VL	145M	584VH	1561L	33VL	6.2	6.8	1.8	14.9	2.5	32.3	52.3	12.0	1.0
SP-16	54200	3.0M	89	9L	7L	97L	1066VH	1619L	73L	6.5		1.4	18.8	1.3	46.6	42.9	7.5	1.7
SP318	54201	1.9L	68	7VL	5**	77L	878VH	1412L	70L	6.0	6.7	2.6	17.4	1.1	41.6	40.5	15.0	1.8
SP430	54202	4.3H	116	5 *	8M	129L	2954VH	1018VL	45VL	8.0		0.0	29.9	1.1	81.2	17.0	0.0	0.7
SP-50	54203	13.3VH	295	12L	18M	80L	1846VH	677VL	92L	6.5		1.6	20.7	1.0	73.3	16.3	7.5	1.9

* Weak Bray unreliable at M or H excess lime or pH > 7.5 ** NaHCO3-P unreliable at this soil pH

SAMPLE NUMBER	Nitrogen NO_3-N ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Excess Lime Rating	Soluble Salts mmhos/cm	Chloride Cl ppm		PARTICLE SIZE ANALYSIS			
												SAND %	SILT %	CLAY %	SOIL TEXTURE
SP-10	9L	5L	1.0L	10M	38VH	1.0M	0.4L	L	0.2VL						
SP-16	16M	5L	0.3VL	10M	25H	1.1M	0.4L	L	0.2VL						
SP318	9L	6L	0.2VL	10M	37VH	1.5H	0.2VL	L	0.1VL						
SP430	7L	7L	0.3VL	2L	19H	1.4H	0.3VL	L	0.1VL						
SP-50	5L	3VL	1.0L	9M	31VH	0.6L	0.4L	L	0.3L						

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).
** ENR - ESTIMATED NITROGEN RELEASE
*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM
**** MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P_2O_5
***** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K_2O
MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEEP

This report applies only to the sample(s) tested. Samples are retained a maximum of thirty days after testing.

Mike Buttress, CPAg
A & L WESTERN LABORATORIES, INC.

A & L WESTERN AGRICULTURAL LABORATORIES

1311 WOODLAND AVE #1 | MODESTO, CALIFORNIA 95351 | (209) 529-4080 | FAX (209) 529-4736

REPORT NUMBER: 09-334-021

CLIENT NO: 2664-D

SEND TO: WINZLER & KELLY ENGINEERS
633 THIRD STREET
EUREKA, CA 95503-

SUBMITTED BY: LIA WEBB

GROWER: REF#10114-09009-33035

DATE OF REPORT: 12/07/09

SOIL ANALYSIS REPORT

SAMPLE ID	LAB NUMBER	Organic Matter		Phosphorus		Potassium	Magnesium	Calcium	Sodium	pH		Hydrogen	Cation Exchange Capacity	PERCENT CATION SATURATION (COMPUTED)				
		* % Rating	** ENR lbs/A	P1 (Weak Bray) **** * ppm	$NaHCO_3$-P (OlsenMethod) **** * ppm	K ***** * ppm	Mg *** * ppm	Ca *** * ppm	Na *** * ppm	Soil pH	Buffer Index	H meq/100g	C.E.C. meq/100g	K %	Mg %	Ca %	H %	Na %
SP-56	54204	4.3H	115	6VL	12M	74L	2330VH	469VL	117L	7.2		0.0	22.2	0.9	86.3	10.5	0.0	2.3
SP-60	54205	4.4H	118	11L	15**	179M	679VH	1334L	88L	5.8	6.6	3.1	16.2	2.8	34.6	41.2	19.0	2.4
SP624	54206	3.2M	93	9L	10**	159M	708VH	1459L	68L	5.9	6.7	2.8	16.6	2.4	35.0	43.8	17.0	1.8

** NaHCO3-P unreliable at this soil pH

SAMPLE NUMBER	Nitrogen NO_3-N ppm	Sulfur SO_4-S ppm	Zinc Zn ppm	Manganese Mn ppm	Iron Fe ppm	Copper Cu ppm	Boron B ppm	Excess Lime Rating	Soluble Salts mmhos/cm	Chloride Cl ppm		PARTICLE SIZE ANALYSIS			
												SAND %	SILT %	CLAY %	SOIL TEXTURE
SP-56	6L	6L	0.5VL	6M	20H	0.6L	0.3VL	L	0.2VL						
SP-60	9L	5L	1.0L	5M	80VH	0.8L	0.2VL	L	0.3L						
SP624	7L	8L	0.4VL	2L	70VH	1.2M	0.2VL	L	0.2VL						

* CODE TO RATING: VERY LOW (VL), LOW (L), MEDIUM (M), HIGH (H), AND VERY HIGH (VH).
** ENR - ESTIMATED NITROGEN RELEASE
*** MULTIPLY THE RESULTS IN ppm BY 2 TO CONVERT TO LBS. PER ACRE OF THE ELEMENTAL FORM
**** MULTIPLY THE RESULTS IN ppm BY 4.6 TO CONVERT TO LBS. PER ACRE P_2O_5
***** MULTIPLY THE RESULTS IN ppm BY 2.4 TO CONVERT TO LBS. PER ACRE K_2O
MOST SOILS WEIGH TWO (2) MILLION POUNDS (DRY WEIGHT) FOR AN ACRE OF SOIL 6-2/3 INCHES DEEP

Mike Buttress, CPAg
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REPORT NUMBER: 09-334-021 **CLIENT:** 2664-D

SUBMITTED BY: LIA WEBB

SEND TO: WINZLER & KELLY ENGINEERS
633 THIRD STREET
EUREKA, CA 95503-

GROWER: REF#10114-09009-33035

DATE OF REPORT: 12/07/09

SOIL FERTILITY GUIDELINES

RATE: /1000 sq **PAGE:** 1

Sample ID	Lab Number	Crop	SOIL AMENDMENTS				Nitrogen N	Phosphate P_2O_5	Potash K_2O	Magnesium Mg	Sulfur SO_4-S	Zinc Zn	Manganese Mn	Iron Fe	Copper Cu	Boron B
			Dolomite	Lime	Gypsum	Elemental Sulfur										
SP-10	54199	GRASSLAND		50			3.0	2.5	3.5		0.6	*				
SP-16	54200	GRASSLAND			100		2.8	2.5	4.5			*				
SP318	54201	WETLAND		70			3.2	4.5	4.5		0.6	*				*
SP430	54202	WETLAND			250	30	3.1	2.0	4.5			*	*			*
SP-50	54203	GRASSLAND			230		2.3	2.0	5.0			*				

COMMENTS

DEPTH OF SAMPLING: Soil fertility could differ greatly with depth. Concentrate on amending and fertilizing the topsoil zone only, but take note of trends down the profile that may need attention.
MAGNESIUM: If base saturation exceeds 25% one may encounter drainage problems and potassium uptake may be hindered. Extra calcium may provide some benefit, but source should depend on soil pH.
AS A GUIDELINE using gypsum, (C.E.C. on report x 130) - (ppm calcium on report) x 0.115 = lb of gypsum required per 1000 sq ft of area to raise a 3-inch depth of soil to 65% calcium saturation.
PRIOR TO PLANTING: Spread the above requirements per 1,000 sq ft and mix into the top 6-8 inches of soil. Initially, limit nitrogen to 1.5 lb/1,000 sq ft or 25-30 ppm NO3-N to avoid salt damage.
SPLIT any extra nitrogen evenly over the active growing season. Adjust rate according to local conditions and requirements. Allow for adequate establishment first (up to 30 days).

NOTES:

Mike Buttress, CPAg
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REPORT NUMBER: 09-334-021 **CLIENT:** 2664-D

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633 THIRD STREET
EUREKA, CA 95503-

GROWER: REF#10114-09009-33035

DATE OF REPORT: 12/07/09

SOIL FERTILITY GUIDELINES

RATE: /1000 sq **PAGE:** 2

Sample ID	Lab Number	Crop	SOIL AMENDMENTS				Nitrogen N	Phosphate P_2O_5	Potash K_2O	Magnesium Mg	Sulfur SO_4-S	Zinc Zn	Manganese Mn	Iron Fe	Copper Cu	Boron B
			Dolomite	Lime	Gypsum	Elemental Sulfur										
SP-56	54204	GRASSLAND			250		3.1	2.0	5.0			*				*
SP-60	54205	WETLAND		90			3.0	3.5	3.5		0.6	*				*
SP624	54206	WETLAND		70			3.2	4.0	3.5		0.6	*	*			*

COMMENTS

MICRONUTRIENTS: Where levels appear to be high, avoid any further applications for the time being. Very high (VH) levels may not necessarily be toxic, but avoid. Maintain correct soil pH. HIGH levels of organic matter should have a beneficial effect on growth and "soil" pH may not be as critical. However, watch carefully as amendments and extra nitrogen may still be necessary.
* MICRONUTRIENTS: Where levels are low, apply according to label instructions. Maintaining correct soil pH and adequate organic matter levels may be sufficient to correct deficiencies.
* BORON may not necessarily be deficient in the soil, and it is hard to correct an excessive application. Therefore, apply boron only if confirmed deficient through a leaf analysis.
WETLAND VEGETATION may include willow, cottonwood, swamp privet, green ash, rushes and sedges. Many species of oak, maple, hickory and rose, may also withstand long wet periods in certain areas.

NOTES:

Mike Buttress, CPAg
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LV

SOIL SAMPLE INFORMATION SHEET

A & L WESTERN AGRICULTURAL LABORATORIES, INC.

LAB USE ONLY

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PORTLAND OFFICE
10220 S.W. NIMBUS AVE., BLDG K-9 • PORTLAND, OR 97223 • (503) 968-9225 FAX (503) 598-7702

N / W / E

CUSTOMER	GROWER	SUBMITTED BY
Winzler + Kelly	WK Ref #:	Lia Webb
633 Third Street	10114-09009-33035	client #2664
Eureka, CA 95501		
PHONE NO: 707-443-8326	PHONE NO:	PHONE NO:

☐ Graphics Report ($1.00 per sample) ☐ Fax Report (____) _____ ☒ Email Report (email address required) liawebb@w-and-s-k.com

SAMPLE ID (6 CHARACTERS)	TEST PACKAGES									CHECK BOX IF RECOMMENDATIONS REQUIRED ☒		LBS PER ACRE ☐	LBS PER 1,000 SQ FT ☒		
	S1B	S1BN	S2	S2N	S3C	S10C	TEXTURE	NEMATODE	OTHER ANALYSES	CROP OR PLANT TYPE	PREVIOUS CROP OR PLANT TYPE	PLANTING DATES	SAMPLE DEPTH	AMENDMENTS APPLIED	METHOD OF IRRIGATION
SP-1(0)					1		NA	NA	grNA	grassland	wildland	Fall 2010	0-6"	NA	
SP-1(6)					1		↓	↓	↓	"	"	"	6-12"	↓	
SP-3(18)					1		↓	↓	↓	wetland	grassland	"	18-24"	↓	
SP-4(30)					1		↓	↓	↓	wetland	"	"	30-36"	↓	
SP-5(0)					1		↓	↓	↓	serpentine grassland	semi-forested	"	0-6"	↓	
SP-5(6)					1		↓	↓	↓	"	"	"	6-12"	↓	
SP-6(0)					1		↓	↓	↓	Wetland	"	"	0-6"	↓	
SP-6(24)					1		↓	↓	↓	"	"	"	24-36"	↓	

EXPLANATION OF TESTS (SUBMIT ABOUT TWO CUPS OF SOIL PER SAMPLE)

S1B: BASIC SOIL ANALYSIS. Organic matter estimated nitrogen release, phosphorus (weak Bray and sodium bicarbonate-P), potassium, magnesium, calcium, sodium, sulfate-sulfur, soil pH, buffer pH, C.E.C. and percent cation saturation (computed).
S1BN: BASIC SOIL ANALYSIS plus nitrate-nitrogen.
S2: BASIC SOIL ANALYSIS plus soluble salts and excess lime.
S2N: BASIC SOIL ANALYSIS plus soluble salts, excess lime, and nitrate-nitrogen.
S3C: COMPLETE ANALYSIS. BASIC SOIL ANALYSIS (plus soluble salts, excess lime, nitrate-nitrogen, Zn, Mn, Fe, Cu, and B).
S10C: COMPLETE ANALYSIS plus saturation percentage, SAR, ESP, carbonate, bicarbonate, chloride, and saturated paste boron.
NOTE: Strong Bray Phosphorus may be substituted for Sodium Bicarbonate Phosphorus in S1B package. Ask for package S1A

NO_3-N = Nitrate - N
SO_4-S = Sulfate - S
Zn = Zinc
Mn = Manganese
Fe = Iron
Cu = Copper
B = Boron
Mo = Molybdenum
Cl = Chloride

PRINT NAME OF SAMPLER Lia Webb
SIGNATURE OF SAMPLER Lia Webb
DATE SAMPLES SUBMITTED 11/24/09

EXPLORATION HOLE LOG

DATE: 11/10/09
PROJECT NAME: SEPUC-HRP
METHOD OF EXPLORATION: hand auger
SAMPLER:
TEST PIT NO.: SP-4

SHEET OF
PROJECT NO.: 16114-09009-33035
LOCATION: Boat Ramp Wetland Creation
LOGGED BY: LLW
TOTAL DEPTH OF HOLE: 3.0'

SOIL DESCRIPTION				COMMENTS	DEPTH	WELL DIAGRAM
DESCRIPTION & REMARKS	COLOR	MOISTURE	STRUCTURE			
clay loam	10YR 2/1	dry	hand auger			
clay	10YR 3/1			dense	1'	
~~gravelly~~ clay loam	10YR 3/1			gravel 5%	2'	sampled 30-36" bgs
gravelly clay loam	10YR 3/1 10YR 5/6 5Y 4/2			gravel 20%	3'	
					4'	
					5'	
					6'	
					7'	

Refusal @ 3' (gravels) Open thistle, impacted vegs
264° W, slope varies ~ 2%

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EXPLORATION HOLE LOG

DATE: 11/10/09
PROJECT NAME: STPUC-HRP
METHOD OF EXPLORATION: hand auger
SAMPLER:
TEST PIT NO.: SP-5a

SHEET OF
PROJECT NO.: 10114-09009-33035
LOCATION: Boat Ramp Fountain Thistle
LOGGED BY: LKW
TOTAL DEPTH OF HOLE: 13" bgs

SOIL DESCRIPTION				COMMENTS	DEPTH	WELL DIAGRAM
DESCRIPTION & REMARKS	COLOR	MOISTURE	STRUCTURE			
2" organic O	10YR3/2	dry	NA	many f-m + coarse roots		subsample 0-6"
loam	10YR3/2					subsample 6-12"
clay loam	10YR3/1				1'	
					2'	
					3'	
					4'	
					5'	
					6'	
					7'	

10% slope, 210° SSW. Refusal @ 1'3" (gravel/rock) Under (closed canopy) pine tree. 3" of needle duff. No GW.

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EXPLORATION HOLE LOG

DATE: 11/10/09
PROJECT NAME: SEPTIC-HRP
METHOD OF EXPLORATION: hand auger
SAMPLER:
TEST PIT NO.: SP-S6

SHEET OF
PROJECT NO.: 10114-09009-33035
LOCATION: Boat Ramp Fountain Thistle
LOGGED BY: LWJ
TOTAL DEPTH OF HOLE: 6"

SOIL DESCRIPTION				COMMENTS	DEPTH	WELL DIAGRAM
DESCRIPTION & REMARKS	COLOR	MOISTURE	STRUCTURE			
clay loam	10YR 3/2	dry	NA	gravels 20%		S6 sample 0-6"
				many fine + course roots	1'	
					2'	
					3'	
					4'	
					5'	
					6'	
					7'	

2% slope, 210° SSW. Refusal @ 6" from root mat (course). Under/near pine, open canopy, 3" needle duff. No GW.

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EXPLORATION HOLE LOG

DATE: 11/10/09
PROJECT NAME: SFPUC - HRP
METHOD OF EXPLORATION: hand auger
SAMPLER:
TEST PIT NO.: SP-5c

SHEET OF
PROJECT NO.: 10114-09009-33035
LOCATION: Boat Ramp Franklin Thistle
LOGGED BY: LLW
TOTAL DEPTH OF HOLE: 6" bgs

SOIL DESCRIPTION				COMMENTS	DEPTH	WELL DIAGRAM
DESCRIPTION & REMARKS	COLOR	MOISTURE	STRUCTURE			
Loam	10YR3/2	dry	NA	gravels 10% ↑		Subsample 0-6"
				many fine + coarser roots	1'	
					2'	
					3'	
					4'	
					5'	
					6'	
					7'	

10% slope, 210° SSW. Refusal at 6" (roots mat). No GW. Pines, open canopy. 2" needle duff.

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EXPLORATION HOLE LOG

DATE: 2/18/10
PROJECT NAME: SFPUC-HRP
METHOD OF EXPLORATION: Hand Auger
SAMPLER:
TEST PIT NO.: BRMW-1

SHEET 1 OF 1
PROJECT NO.: 10114-09001-33091
LOCATION: Boat Ramp
LOGGED BY: Schwarz/Knapek
TOTAL DEPTH OF HOLE: 3.0

Top of Casing (TOC) 11 1/4" Above Ground Surface (AGS)

SOIL DESCRIPTION				COMMENTS	DEPTH	WELL DIAGRAM
DESCRIPTION & REMARKS	COLOR	MOISTURE	STRUCTURE	TEXTURE		
	7.5YR 2.5/1	M	M	SIL 20% clay range of sands-VF		11 1/4"
	7.5YR 2.5/1	M	M	GRSICL 27% Clay +15% GR (FtoM)	1'	bentonite
	7.5YR 2.5/1	M	M	XGRSICL 60% GR (FtoM) very very sticky	2'	sand
	7.5 YR 2.5/1	M	M	GRSICL 20% GR (F to M)	3'	#2 sand
	- Terminates at 3.0' -					
	Groundwater at ≈ 15" appears to be perched on clay layer.				4'	
					5'	
					6'	
					7'	

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EXPLORATION HOLE LOG

DATE: 2/18/10
PROJECT NAME: SEPUC - HRP
METHOD OF EXPLORATION: Hand Auger
SAMPLER:
TEST PIT NO.: BRMW-2

SHEET 1 OF 1
PROJECT NO.: 10114-09001-33041
LOCATION: Boat Ramp
LOGGED BY: Schwarz / Knapek
TOTAL DEPTH OF HOLE: 3.0'

Top of Casing 12.0" AGS

SOIL DESCRIPTION						
DESCRIPTION & REMARKS	COLOR	MOISTURE	STRUCTURE	~~COMMENTS~~ TEXTURE	DEPTH	WELL DIAGRAM
	7.5 YR 2.5/1	M	M	L 20% clay Reismere sticky tran blotchy		12.0" bentonite
	7.5 YR 2.5/1	M	M	GR SICL +27% clay 20% GR - larger than below	1'	sand
	7.5 YR 2.5/1	M	M	GR SICL +27% clay 25% GR	2'	perf
	7.5 YR 2.5/1	M	M	SICL +27% clay		
	- Terminates at 3.0' - Water at surface appears to be perched on clay layer				3' 4' 5' 6' 7'	

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EXPLORATION HOLE LOG

DATE: 2/18/10
PROJECT NAME: Boat Ramp - SFPUC
METHOD OF EXPLORATION: Hand Au
SAMPLER: Schwarz
TEST PIT NO.: BRMW-3

SHEET 1 OF 1
PROJECT NO.: 10114-09001-33041
LOCATION: Boat Ramp
LOGGED BY: Schwarz / Knapek
TOTAL DEPTH OF HOLE: 3.0'

Top of Casing 12.0" AGS

SOIL DESCRIPTION						
DESCRIPTION & REMARKS	COLOR	MOISTURE	STRUCTURE	~~COMMENTS~~ TEXTURE	DEPTH	WELL DIAGRAM
	10YR 2/1	M	M	L w/ 19% vf, f, m sands		12" Bentonite
	7.5YR 2.5/1	M	M	L w/ vf, f, m sands	1'	Sand
	7.5YR 2.5/1, 99%. 10YR 5/3, 1%. Depletions, matrix & large root pores	M	M	L w/ vf-coc sands/rock chips	2'	Perf
	5YR 4/3 7.5YR 2.5/1	M	M	GRFSICL +2%		
	-Terminates at 3.0'-				3'	
					4'	
					5'	
					6'	
					7'	

WINZLER & KELLY
CONSULTING ENGINEERS

Appendix D
Hydrology

Boat Ramp Hydrology Report

July 2010

Prepared for

SFPUC
WATER
HETCH HETCHY WATER & POWER
CLEAN WATER

Prepared by

WINZLER & KELLY

Section 1 Introduction

The Boat Ramp project is included in the San Francisco Public Utilities Commission (SFPUC) Habitat Reserve Program, which mitigates for the Water System Improvement Program (WSIP). The goals of the Boat Ramp project are to enhance and create seasonal wetland, and create and enhance serpentine grassland and expand available fountain thistle habitat. The mitigation will provide habitat for the California red-legged frog and for the San Francisco garter snake, among several nesting birds and mammals with California species of special concern status.

Winzler & Kelly's team is providing environmental planning, biologic, hydrologic and engineering design services. This Report summarizes the hydrologic analysis that serves as a basis for the design of the proposed seasonal wetlands.

Section 2 Existing Conditions

Boat Ramp Wetland Creation Watersheds

Refer to **Figure 1** for watershed data. The watershed delineation was based on topographic data gathered from the SFPUC, USGS digital elevation models, and additional survey points collected by SFPUC at the project site. The hydrologic surface water calculations relate only to the wetland creation site of the Boat Ramp project. The discussion of groundwater as it pertains to soil moisture for the Fountain Thistle project area will be discussed in **Section 4 – Fountain Thistle Soil Moisture**.

Figure 2 shows the Boat Ramp project areas. The Boat Ramp sites are located on a gentle west-facing slope on the eastern shoreline of Lower Crystal Springs Reservoir site. There is an existing intermittent creek trending east to west through the center of the wetland creation site towards Lower Crystal Springs.

Three watersheds (WS-1 through WS-3) provide water to the Boat Ramp wetland creation project area, having a total area of approximately 63 acres. Landuse for the sub-watersheds include shrub land and grassland. The watershed characteristics are summarized in **Table 1**.

Table 1 – Watershed Characteristics

Watershed	Area (acres)	Drainage Length (ft)	High Elev (ft)	Low Elev (ft)	Δ Elev (ft)	Average Slope (ft/ft)
WS-1	11.13	959	483	386	97	0.10
WS-2	2.97	465	450	390	60	0.13
WS-3	2.23	445	226	187	39	0.09

The runoff from WS-3 flows to the intermittent stream by sheet flow, where it is collected and conveyed toward the proposed wetland area. Runoff from WS-1 and WS-2 is collected and conveyed by a system of pipes that were built by Caltrans during the construction of Highway 280 (HWY 280). Runoff from watersheds WS-1 and WS-2 is collected and routed under the highway to a main conveyance pipe that discharges into the intermittent creek and is conveyed towards Lower Crystal Springs. It is assumed that

runoff from HWY 280, for a storm event as large as the 100-year, is self contained through the drainage system shown in the As Built Plans for HWY 280 (see **Appendix A)**.

Field Data

Figure 2 indicates the locations of stream gages, piezometers, and soil moisture meters, and **Table 2** summarizes data used in this report. Winzler & Kelly installed an automated water level gage (stream gage) in the intermittent stream upstream from the existing SFPUC road crossing. Data from the stream gage was collected on an hourly basis, from January 2010 through May 2010, and was converted to flow using the channel geometry from field data and Manning's equation. A rating curve for the channel was created for use in the hydrologic model. The stream gage data can be viewed in **Appendix B.**

Table 2 – Summary of Field Data

Source	Type	Period	Application
Winzler & Kelly	Stream Gage/Water Level	01/10 - 05/10	Hydrologic Model Calibration
Winzler & Kelly	Piezometer	02/10 - 05/10	Wetland Drawdown Time
Winzler & Kelly	Soil Moisture Meter	02/10 - 06/10	Fountain Thistle Soil Moisture
SFPUC	Rain Gage	10/09 - 5/10	Hydrologic Model Calibration

Three piezometers were installed in the project area by Winzler & Kelly to measure the ground water levels during the spring and summer drying period. The piezometers were installed in March 2009 and monitoring occurred from the date of installation through the May of 2010. Based on one year of data from the three piezometers , the groundwater recession averages 0.74 inches/day. The collected data for the three piezometers can be viewed in **Appendix B**.

The soil moisture meters will be discussed in **Section 4**.

Hourly Rainfall data from the Crystal Springs Cottage gage station, located approximately 2 miles southeast of the project area, was used in this analysis. The rain gage data for January 2010 through May 2010 was correlated with the stream gage data to develop a calibrated hydrologic model of the delineated watersheds. Historical rain data were entered into the calibrated model to determine the runoff volume available for the proposed wetlands on an annual basis. This volume was used as the basis for the sizing of the proposed seasonal wetlands and determining what impact, if any, retaining additional runoff in the wetland would have on existing hydrodynamics. Cumulative and rainfall data for 1999 through 2010 and incremental rainfall data for the 2009/2010 rainfall data can be viewed in **Appendix B**.

Hydrologic Model

Extended Period Simulation

The United States Army Corps of Engineers hydrologic software model, HEC-HMS, was used for this analysis. An Extended Period Simulation (EPS) model was developed using rain gage data from the San Andreas Cottage and Crystal Springs Cottage gage stations. An EPS model computes runoff as a result of a rainfall event or series of events input by the user. This is different from event-based modeling, which simulates runoff from a statistical storm event, such as the 100-year, 24-hour storm. An EPS model is suited for the analysis of Upper San Mateo Creek because the design criteria for the proposed wetlands

are based on the historical seasonal volume of water from the respective watershed and not on a single event. Hourly precipitation data extending from March 2, 2010, through March 6, 2010, was used to calibrate the HEC-HMS model with the observed stream gage. Once calibrated, the HEC-HMS model used hourly rain data from October 1999 through May 2010 for an analysis of the effects of dry, average and wet rainfall years on the proposed wetlands.

The HEC-HMS model was calibrated by adjusting parameters of each sub-watershed within a threshold that depicts the hydrologic characteristics of each sub-watershed. The parameters adjusted were the rainfall losses associated with infiltration and the storage coefficient within the hydrograph convolution method.

Rainfall Losses

The Deficit Constant Loss method was used to account for losses due to infiltration. This method is appropriate for extended period simulations as it accounts for evapotranspiration and the resulting drying of soil in between storms. Initial inputs are based on NRCS soil properties shown in **Appendix C**. The model modifies the most sensitive parameter, the constant rate of loss (inches/hour), during model calibration. **Appendix D** shows the sub-watersheds final values for the rainfall losses.

Hydrograph Convolution

The Clark Unit Hydrograph synthetic unit hydrograph method was used for hydrograph convolution. This method uses time of concentration to define the maximum travel time within a sub-watershed and applies a storage coefficient to simulate attenuation of flow. The storage coefficient, R, is an index of precipitation excess in the watershed as it drains to the outlet point. Though R has units of time (hr), there is only a qualitative meaning for the value. As recommended by the *Hydrologic Modeling System HEC-HMS Technical Reference Manual* (March 2000), "R can be estimated via calibration if gaged precipitation and stream flow data are available." The HEC-HMS model was used in conjunction with the observed 2009/2010 rainfall and stream gage data to estimate the value of R. **Appendix D** shows the calibrated parameters.

Calibrated Model

The calibrated HEC-HMS existing conditions model using 2009/2010 rainfall and stream gage data predicts the volume within an acceptable level of accuracy. The model output hydrograph and the hydrograph generated from data collected by the main channel stream gage are shown in **Figure 3**. **Table 3** compares observed versus modeled output.

Table 3 - Output Comparison

	Peak Flow (cfs)	Time of Peak Flow	Total Runoff Volume (ac-ft)
Computed Results	0.4	3/4/2010 14:10	1.0
Observed Stream Gage Results	0.54	3/4/2010 11:00	1.04

Section 3 Proposed Wetland

Design Criteria

The proposed wetland is intended to serve as seasonal wetlands, defined for the purpose of this project as habitat for California red-legged frogs, San Francisco garter snakes and other California species of concern. During an average year of rainfall, it is the design goal that the wetland holds water until early May.

Based on information provided by SFPUC, Swaim Biological, and local successful frog ponds, Winzler & Kelly developed conceptual elements for the proposed wetlands. Design concepts include incorporation of a mild bank slope into a shallow end to allow access and to promote vegetative growth, incorporation of a steep bank slope at a deep end to provide shelter from predators; incorporation of structure within the pond for additional shelter. The proposed grading plan is based on these concepts.

Geometry

The size of the proposed wetlands is limited by site constraints, such as topography and available volume of water from the respective watersheds. The area and depth of the proposed wetlands maximizes the amount of created seasonal wetlands needed by SFPUC for mitigation and minimizes the volume of water intercepted from the watershed. Refer to **Figure 2** for the proposed footprint of the proposed wetlands. The proposed wetland will have varying depths with a maximum ponding depth of 4 feet creating approximately 0.4 acre-feet of storage.

Hydrologic Model

Proposed Wetland Filling

The calibrated HEC-HMS model was used to quantify the volume of runoff available for the proposed wetland shown in **Figure 2**. Based on the calibrated HEC-HMS model for the 2009/2010 rainy season, there was approximately 21.2 acre-feet of water from the watersheds which will feed the proposed wetland. **Table 4** provides the calculated historical volume of water available to the proposed wetlands. As shown in the table, the proposed size of the wetlands is a negligible percentage of the total available volume. The historical volume quantities are based on hourly rainfall data from the San Andreas Cottage and Crystal Springs Cottage rain gages from October 1999 through March 2010 and the calibrated HEC-HMS model. Based on the historical rain data, the wetlands are likely to fill after the first two storm events.

Table 4 – Historical Water Volume

Rainy Season	WS-1 (ac-ft)
1999/2000	24.6
2000/2001	19.6
2001/2002	18.4
2003/2004	19.7
2004/2005	33.3
2005/2006	33.8
2006/2007	10.5
2007/2008	21.6
2008/2009	20.5
2009/2010	21.2

*2002/2003 data not shown because of missing rainfall data for that season

Wetland Draining

A calibrated hydrologic recession model was also used to determine historically when the water surface elevation (WSE) begins to recede. The hydrologic recession model accounts for the WSE after the last rainfall event and begins draining the pond due to losses. The losses in the pond are associated with infiltration and evapotranspiration. The infiltration rate, 0.74 inches per day, is based on the piezometer groundwater recession trend from the one year of data.

The evapotranspiration rates are based on monthly averages from the California Irrigation Management Information System (CIMIS) evapotranspiration gage #96 located in Woodside, CA. The monthly average evapotranspiration rates are shown in **Appendix C.,** and range from 1.83 to 6.47 inches per month.

Based on the calibrated hydrologic runoff model, calibrated hydrologic pond recession model, and the proposed wetland geometry, the estimated date that the proposed pond would have historically been dry is summarized in **Table 5**. The recession of the WSE can be viewed in **Figure 4**.

Table 5 – Estimated Historical Drying Date for the Proposed Wetlands

Rainy Season	Estimated Dry Date	Classification
1999/2000	May 3, 2000	Wet
2000/2001	April 29, 2001	Average
2001/2002	March 2, 2002	Average
2003/2004	April 24, 2004	Dry
2004/2005	May 22, 2005	Wet
2005/2006	June 8, 2006	Wet
2006/2007	April 25, 2007	Dry
2007/2008	April 20, 2008	Average
2008/2009	April 29, 2009	Dry
2009/2010	June 17, 2010	Wet

Proposed Wetland Culvert

As part of the wetland design, an overflow culvert will be placed within the wetland to allow the continuation of water flowing towards Lower Crystal Springs Reservoir. The culvert will be place at the same location as the existing culvert that conveys water under the existing boat ramp road as shown in **Figure 2**. The invert of the culvert will be placed at elevation 292, which will allow a maximum of 4 feet to pond within the wetland before flow is conveyed downstream. The approximate maximum storage of the wetland is 0.4 acre-feet, and according to the calibrated HEC-HMS model, the wetland will reach capacity after the first storm event. Once the wetland is at storage capacity, additional flow will be conveyed by the overflow culvert towards Lower Crystal Springs Reservoir. **Table 6** summarizes the historical date that the proposed wetland would have reached capacity.

Table 6 – Wetland Capacity Date

Rainy Season	Wetland Capacity Date
1999/2000	November 8, 1999
2000/2001	October 26, 2000
2001/2002	November 12, 2001
2003/2004	November 9, 2003
2004/2005	October 19, 2004
2005/2006	December 2, 2005
2006/2007	November 15, 2006
2007/2008	October 11, 2007
2008/2009	November 1, 2008
2009/2010	October 13, 2009

The size of the overflow culvert is designed based on the 100-year design storm event to ensure that the maximum water elevation in the wetland is 1 foot below the boat ramp road. The road is being re-graded as part of the wetland design and will have an elevation of 296, 8 feet above the bottom of the wetland. The design for the culvert used the rational equation with the parameters shown in **Table 7** to derive the 100-year storm. The 100-year rainfall intensity is based on rainfall-duration-frequency data from the NOAA Station at San Francisco International Airport.

Table 7 – 100 Year Flow Design Parameters

	WS-1	WS-2	WS-3
Coefficient (C)	0.35	0.35	0.35
100-year Rainfall Intensity (I_{100})	3.3 in/hr	4.2 in /hr	4.8 in/hr
Watershed Area (A)	11.13 ac	2.97 ac	2.23 ac
100-year Flow (Q_{100})	12.85 cfs	4.37 cfs	3.75
Combined Q_{100}	20.97 cfs		

Based on the 100-year flow and 1-foot freeboard requirement, the overflow culvert will have the characteristics shown in **Table 8**.

Table 8 – Overflow Culvert

Diameter	24-in
Invert Elevation	292’
Slope (ft/ft)	0.02
Material	RCP

The rating curve for the culvert can be viewed in **Appendix D.**

Section 4 Fountain Thistle Soil Moisture

Field Data

Winzler & Kelly installed automated soil moisture meters in a transect located within the Fountain Thistle project area as shown in **Figure 2**. The soil moisture meters were placed 18-inches into the soil and approximately 50 feet apart from one another progressing up the western facing hill with SM-1 being at the lowest elevation and SM-7 being at the highest elevation. **Table 9** summarizes the location of the soil moisture meters.

Table 9 – Soil Moisture Meter Locations

	Existing Grade Elevation (ft)	Within Fountain Thistle Population?
SM-1	287.63	Yes
SM-2	294.28	Yes
SM-3	299.62	Yes
SM-4	309.19	No
SM-5	319.72	No
SM-6	324.76	No
SM-7	330.07	No

Data from the soil moisture meters was collected on an hourly basis, from February 2010 through June 2010, and was plotted to view the trend of the soil moisture throughout the rainy season and as the project area dries. The soil moisture plot can be view in **Figure 5**.

As shown in **Figure 5**, the soil moisture meters within the fountain thistle population (SM-1 through SM-3) constantly have the highest soil moisture content during the period of measurement with the exception of SM-5. The high water content at SM-5 can be attributed to relatively shallow bedrock which caused the ground water to be perched next to the soil moisture meter. This is evident by the rapid drawdown during periods of dry weather similar to SM-4 and SM-6. Bedrock at SM-4 and SM-6 was not encountered during installation of the meters, whereas it was during the installation of SM-5.

The soil moisture plot also shows that the soil moisture stays within the fountain thistle population stays fairly constant with spikes during rain events. The soil moisture drawdown for SM-1 through SM-3 during dry periods is much slower when compared to SM-4 through SM-7. This corresponds to the capability of the soil within the fountain thistle population to maintain saturation even during "dry" periods. This is evident in **Figure 5** from the time period of approximately April 26 through May 26. The soil moisture for SM-1 though SM-3 stays constant while it quickly decreases in SM-4 through SM-7 during this time period. The consistency of the soil moisture within the fountain thistle population area is likely due to the combination of a decrease in slope of the terrain and the proximity of the area to Lower Crystal Springs Reservoir. The slope of the terrain and the water surface elevation of Lower Crystal Springs Reservoir affect the ground water table which in turn contributes to soil moisture.

Field Observations

The following items were observed in the field at the fountain thistle project area:

- Groundwater flows out of the hillside and becomes sheet flow about 10 feet away from Lower Crystal Springs Reservoir
- The turbid water discharge line built by Caltrans and as shown in **Appendix A** is not leaking a significant volume of water that is providing water to the fountain thistle project area. This was observed in the field by measuring the flow of water with a flow meter entering the Retarding Basin #3 outlet and measuring the flow downstream the turbid discharge line at a manhole just north of Retarding Basin #4. The flows were similar therefore it can be concluded that the turbid discharge line is not leaking a significant amount of water within the proximity of the fountain thistle project area.

Based on the analysis of the soil moisture, field observations, and no other factors that may contribute to the growth of fountain thistle, increasing the soil moisture content and the capability of the soil to maintain saturation for longer periods of time may aid in expanding the fountain thistle population. Some methods for increasing the soil moisture content and length of saturation may include: raising the water surface elevation of Lower Crystal Springs Reservoir to raise the groundwater table; remove vegetation that greatly reduce the soil moisture due to transpiration; reduce the slope of the terrain through grading.

Section 5 Conclusion

Based on the hydrologic analysis and information provided by SFPUC, the watersheds tributary to the proposed wetlands provide sufficient runoff to sustain the wetlands and be provide foraging habitat for California red-legged frogs and habitat for San Francisco garter snakes. Based on calibrated models, the wetlands will be at capacity after the first significant rainfall event and would drain by late spring.

Soil moisture content and the length of saturation appear to aid in the growth of the fountain thistle and the project area may benefit from removing the pine trees within the project area. This may decrease the localized transpiration rate and increase the soil moisture content. Further investigation into other possible components of the plants growth should occur before characterizing the type of environment that fountain thistles thrive in.

FIGURES

CITY AND COUNTY OF SAN FRANCISCO
PUBLIC UTILITIES COMMISSION

SFPUC
WATER
HETCH HETCHY WATER & POWER
CLEAN WATER

HABITAT RESERVE PROGRAM
BOAT RAMP
CONTRACT NO. WD-2641

WINZLER & KELLY

Legend

- Culvert
- Primary Highway
- Secondary Highway
- Fountain Thistle Project Area
- Wetland Creation Project Area
- Caltrans Pipe
- Watershed
- Intermittent Stream

N

0 50 100 200 Feet
1 inch = 200 feet

WATERSHED MAP

FIGURE
1

CITY AND COUNTY OF SAN FRANCISCO
PUBLIC UTILITIES COMMISSION

SFPUC
WATER
HETCH HETCHY WATER & POWER
CLEAN WATER

HABITAT RESERVE PROGRAM
BOAT RAMP
CONTRACT NO. WD-2641

WINZLER & KELLY

Legend

- Proposed Wetland
- Fountain Thistle Project Area
- Wetland Creation Project Area
- Piezometer
- Soil Moisture Meter
- Stream Gage
- Culvert
- Intermittent Stream

N

0 25 50 100 Feet
1 inch = 100 feet

PROJECT AREA MAP

FIGURE
2

Figure 3 - Boat Ramp Intermittent Creek Flow Calibration

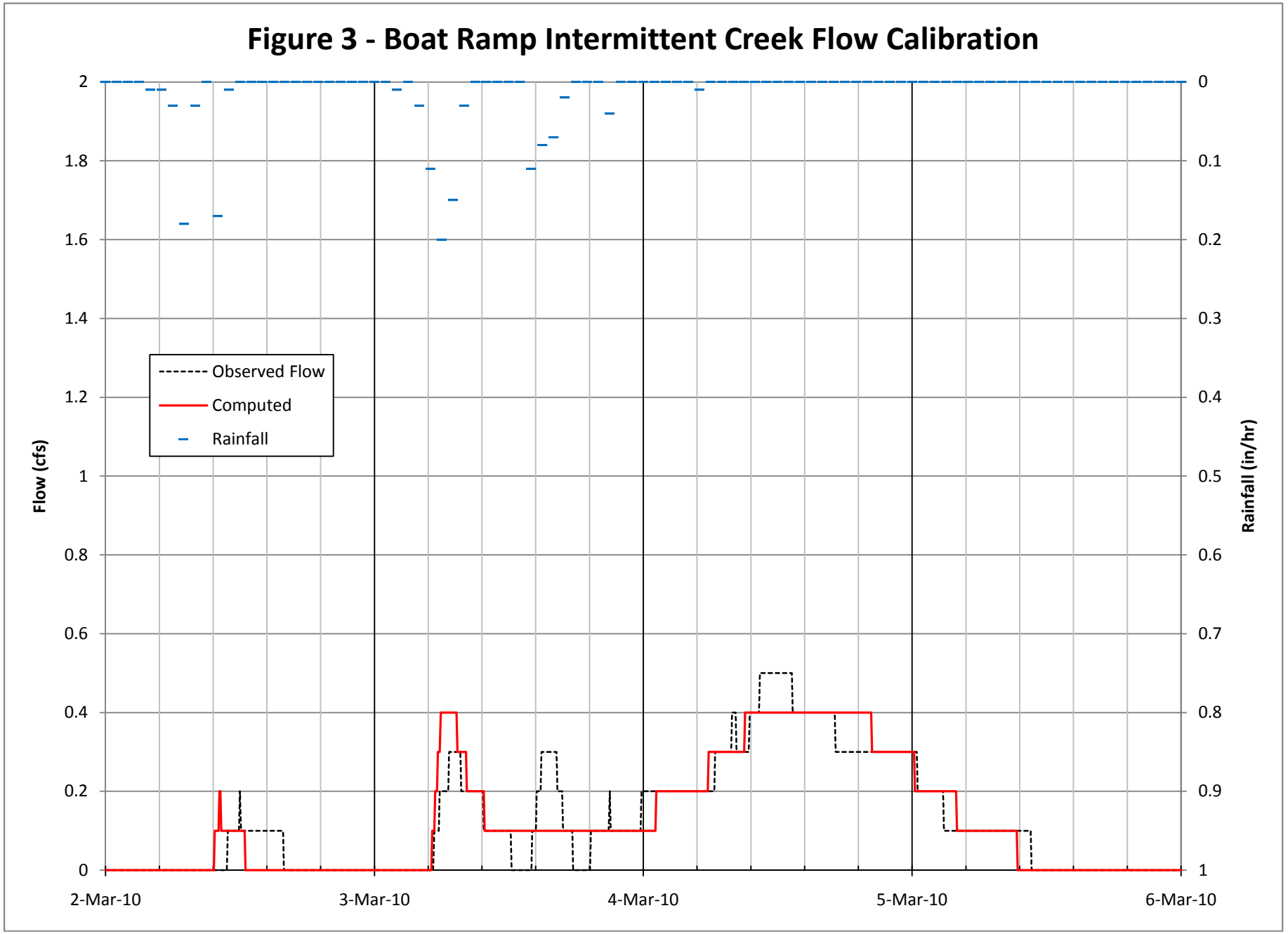


Figure 4 - Proposed Wetland Historical "Dry" Date

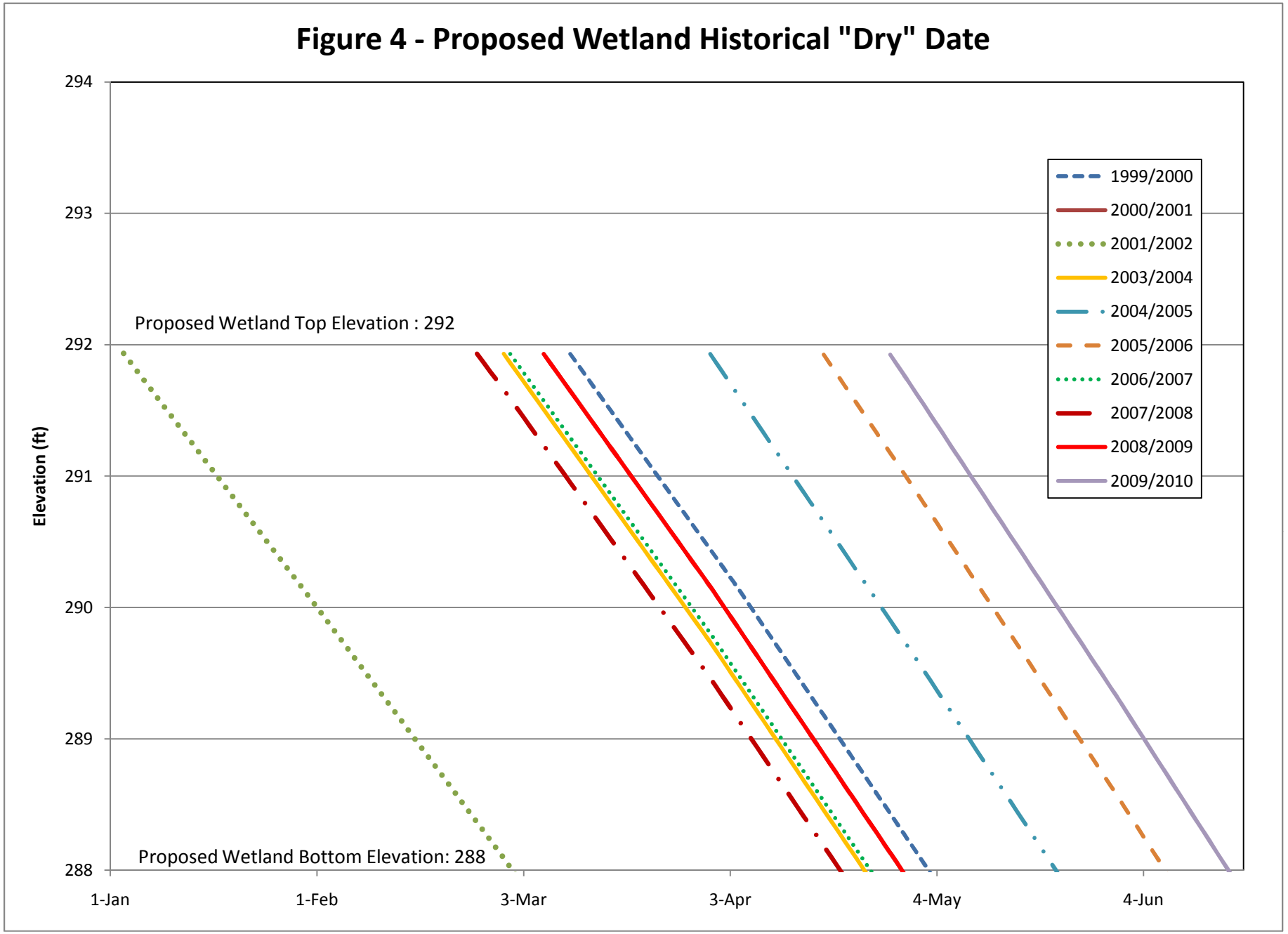
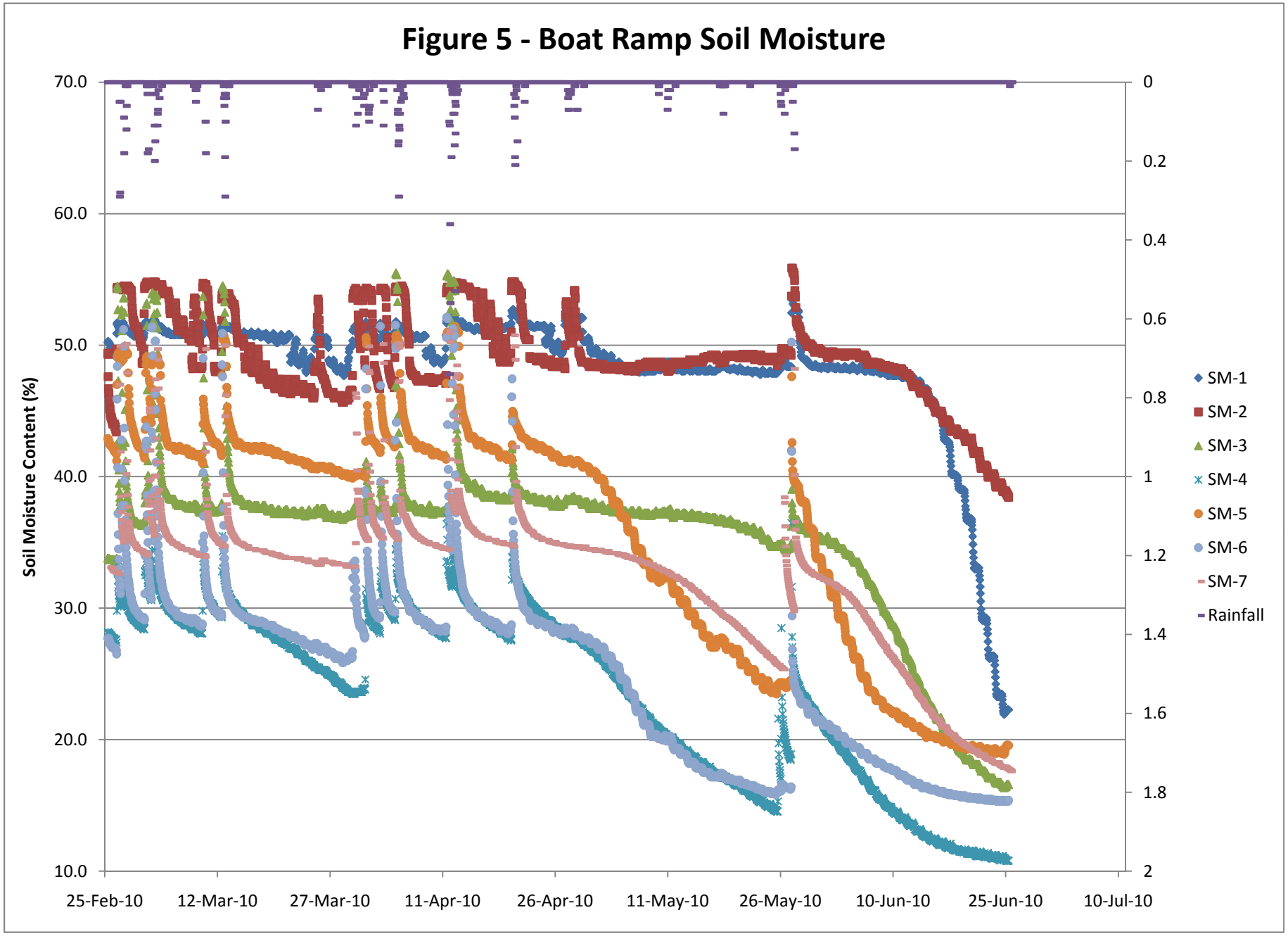


Figure 5 - Boat Ramp Soil Moisture



APPENDIX A
CALTRANS AS-BUILT

I-280-1(207) 33

DIST.	COUNTY	ROUTE	POST MILE—TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
04	S.M.	280	T10.7/R12.7	1	98

INDEX OF SHEETS

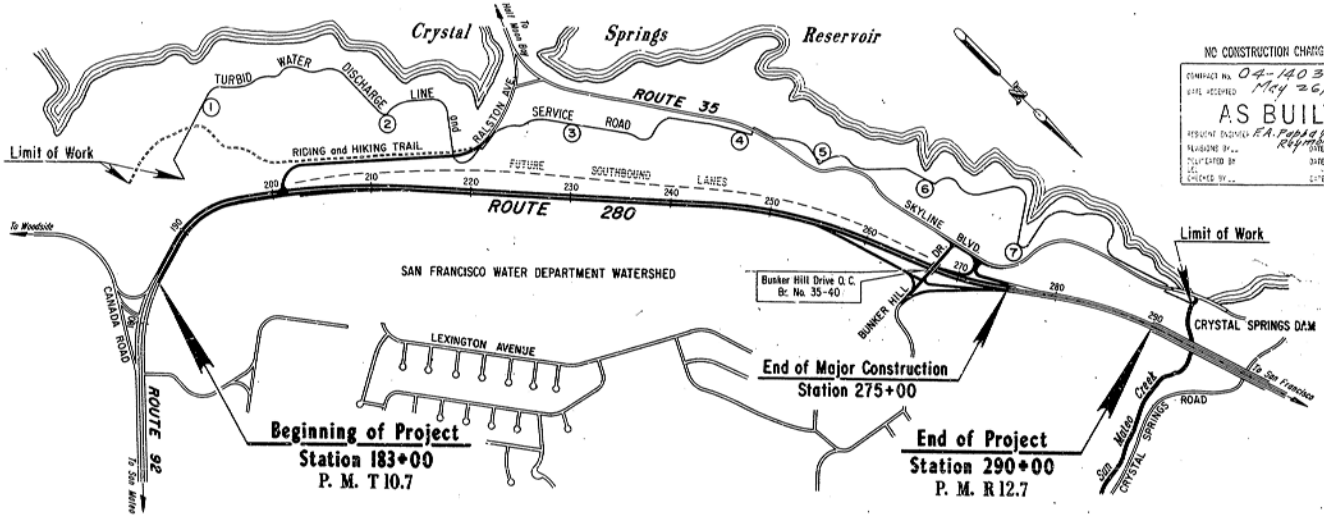
STATE OF CALIFORNIA
TRANSPORTATION AGENCY
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

PROJECT PLANS FOR CONSTRUCTION ON STATE HIGHWAY

In San Mateo County
between Route 92 near Belmont and 0.1 mile north of Bunker Hill Drive

To be supplemented by Standard Plans dated November, 1966
being the detail plans of a portion of the route for the
State highway adopted by the California Highway Commission
on July 23, 1958 and declared a
FREEWAY
by resolution of the California Highway Commission
on July 23, 1958

LOCATION MAP



NO CONSTRUCTION CHANGES
CONTRACT No. 04-140394
DATE ACCEPTED May 26, 1969
AS BUILT
RESIDENT ENGINEER E.A. Pupp & E.A. Raymond
REMARKS BY ... DATE
DELINEATED BY ... DATE
CHECKED BY ... DATE

LEGEND
(No.) RETARDING BASIN

SCALE IN FEET
500 0 500 1000

Length of Major Construction = 1.7 miles
Length of Project = 2.0 miles

AS BUILT PLANS
Contract No. 04-140394
Date Completed
Document No. 4000 1987

Approved January 2, 1968

Contract No. 04-140394

Drawn by	Date
JG Kundert	12-67
Checked by	Date

Project Engineer	Date	Design Engineer	Date	Approval Recommended By	Date
G. Matsui	12/67	P. B. Jensen	12/67	H. K. Taylor	12/67

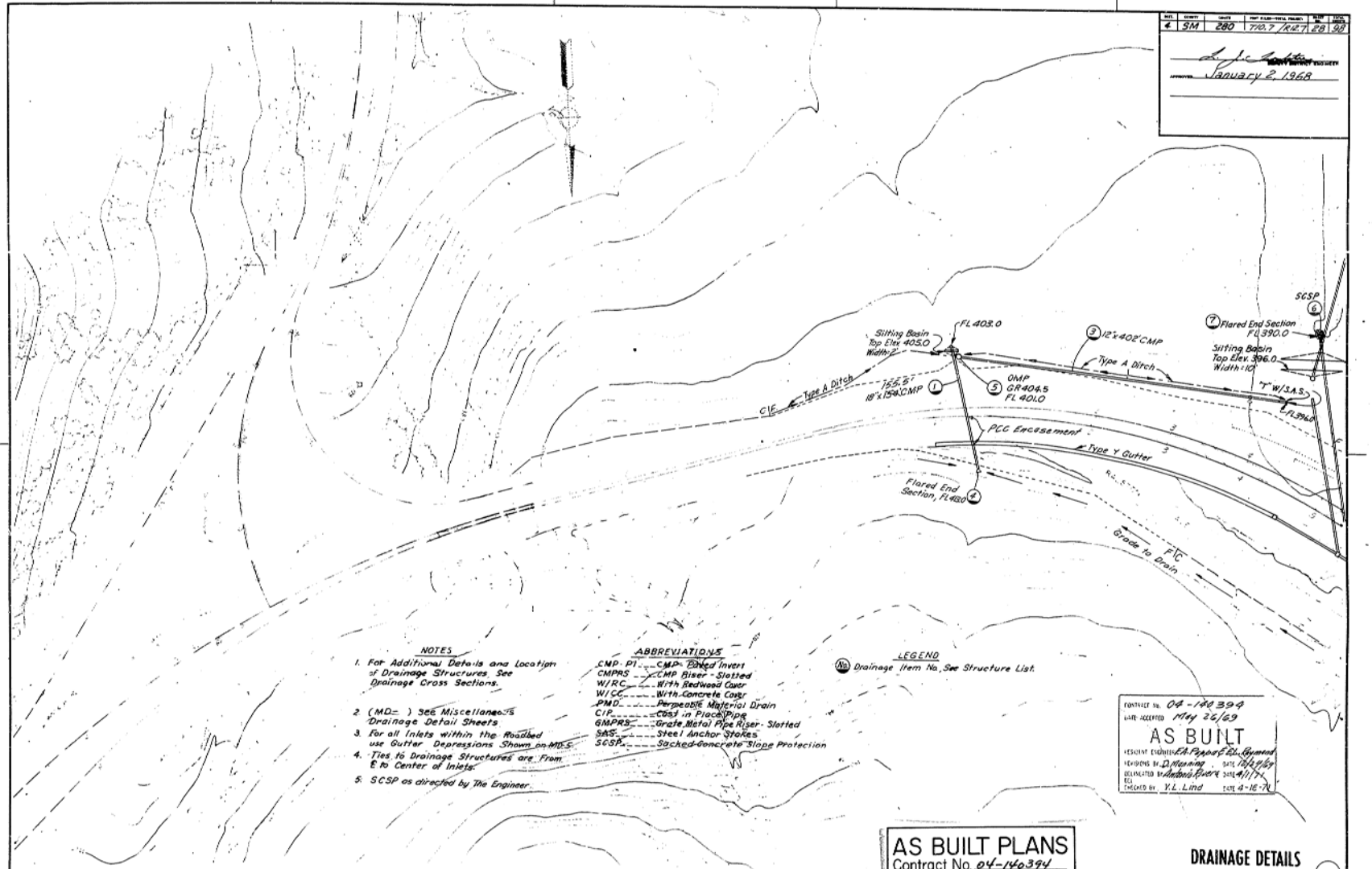
04209 14-371

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 7/6/71 SIGNATURE [illegible] TITLE HAO II

DIST.	COUNTY	ROUTE	POST MILE—TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
4	SM	280	7.10.7 / R12.7	28	98

APPROVED January 2, 1968



NOTES

1. For Additional Details and Location of Drainage Structures See Drainage Cross Sections.
2. (MD-) See Miscellaneous Drainage Detail Sheets
3. For all Inlets within the Roadbed use Gutter Depressions Shown on MD-5
4. Ties to Drainage Structures are From ℄ to Center of Inlets.
5. SCSP as directed by The Engineer.

ABBREVIATIONS

CMP PI	CMP- Paved Invert
CMPRS	CMP Riser - Slotted
W/RC	With Redwood Cover
W/CC	With Concrete Cover
PMD	Perpeable Material Drain
CIP	Cast in Place Pipe
GMPRS	Grate Metal Pipe Riser - Slotted
SAS	Steel Anchor Stakes
SCSP	Sacked Concrete Slope Protection

LEGEND

(No.) Drainage Item No. See Structure List.

CONTRACT No. 04-140394
DATE ACCEPTED May 26, 1969

AS BUILT

RESIDENT ENGINEER E.A. Pepper & E.L. Caymen
REVISIONS BY D. Manning DATE 12-19-69
DELINEATED BY Antonio Rivera DATE 4/1/70
ECI
CHECKED BY Y.L. Lind DATE 4-16-70

Project Engineer	Date	Design Engineer	Date	Approval Recommended By	Date
G. Matsei	12/67	P.B. Jansen	10/67	H.S. Taylor	10/67

AS BUILT PLANS
Contract No. 04-140394
Date Completed
Document No. 4000187

DRAINAGE DETAILS

Scale: 1" = 50'

D-1

140391

28

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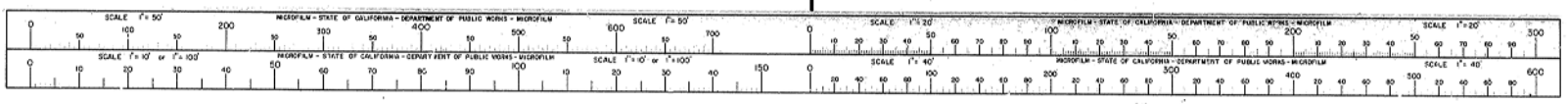
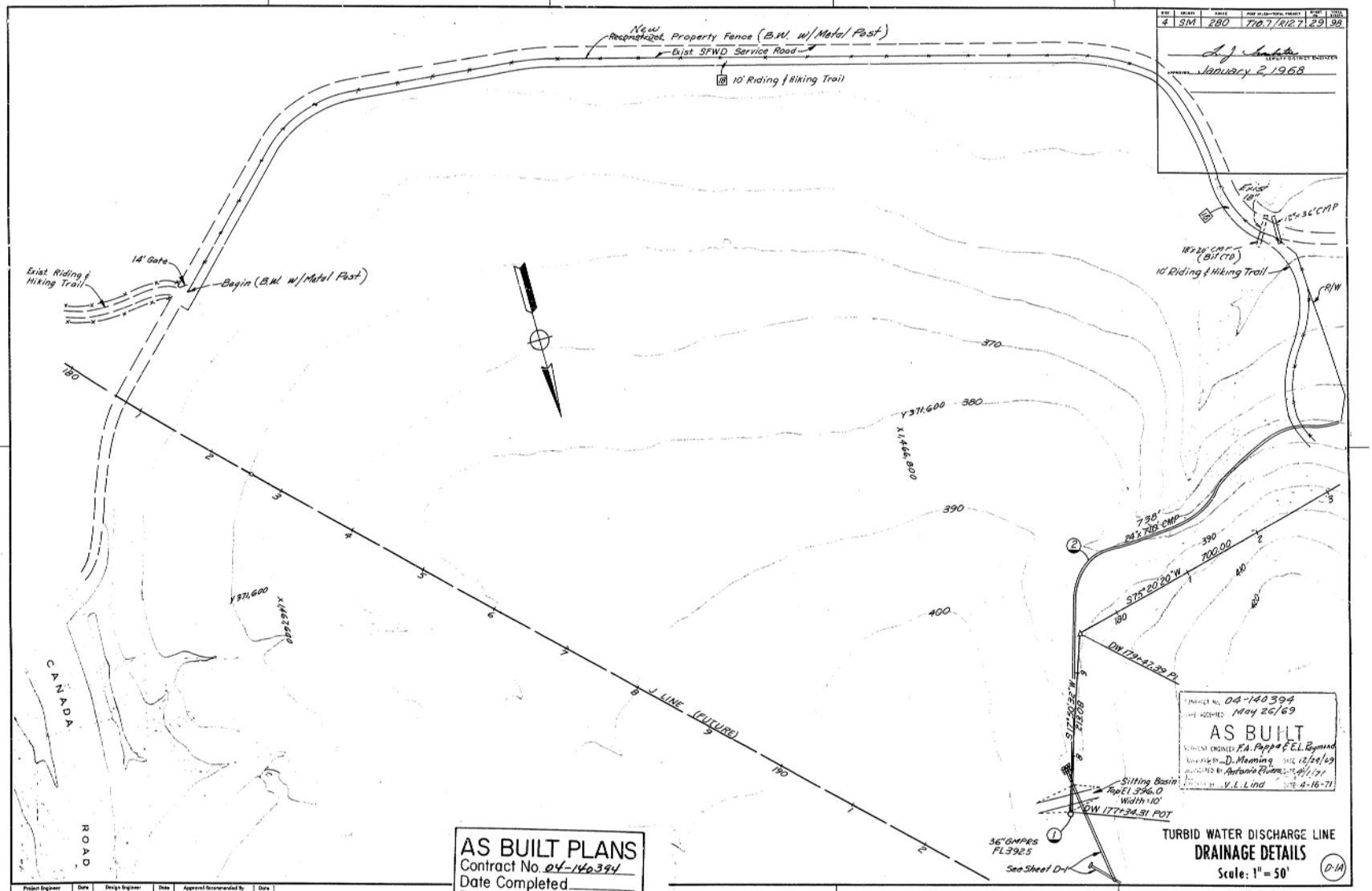
DATE 7/6/71 SIGNATURE J.C. Kyle TITLE HAO II





Project Engineer	Date	Design Engineer	Date	Approval Recommended By	Date
G. Matsui	10/67	P.E. Jansen	12-67	R.K. Taylor	10/67

AS BUILT PLANS
Contract No. 04-140394
Date Completed
Document No. 40001987

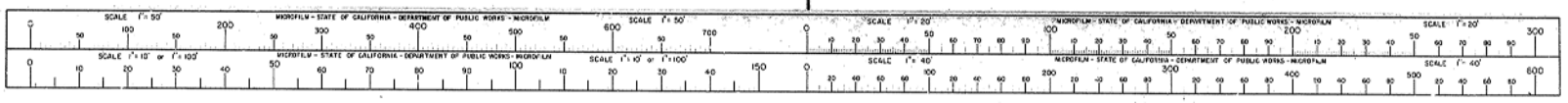
29

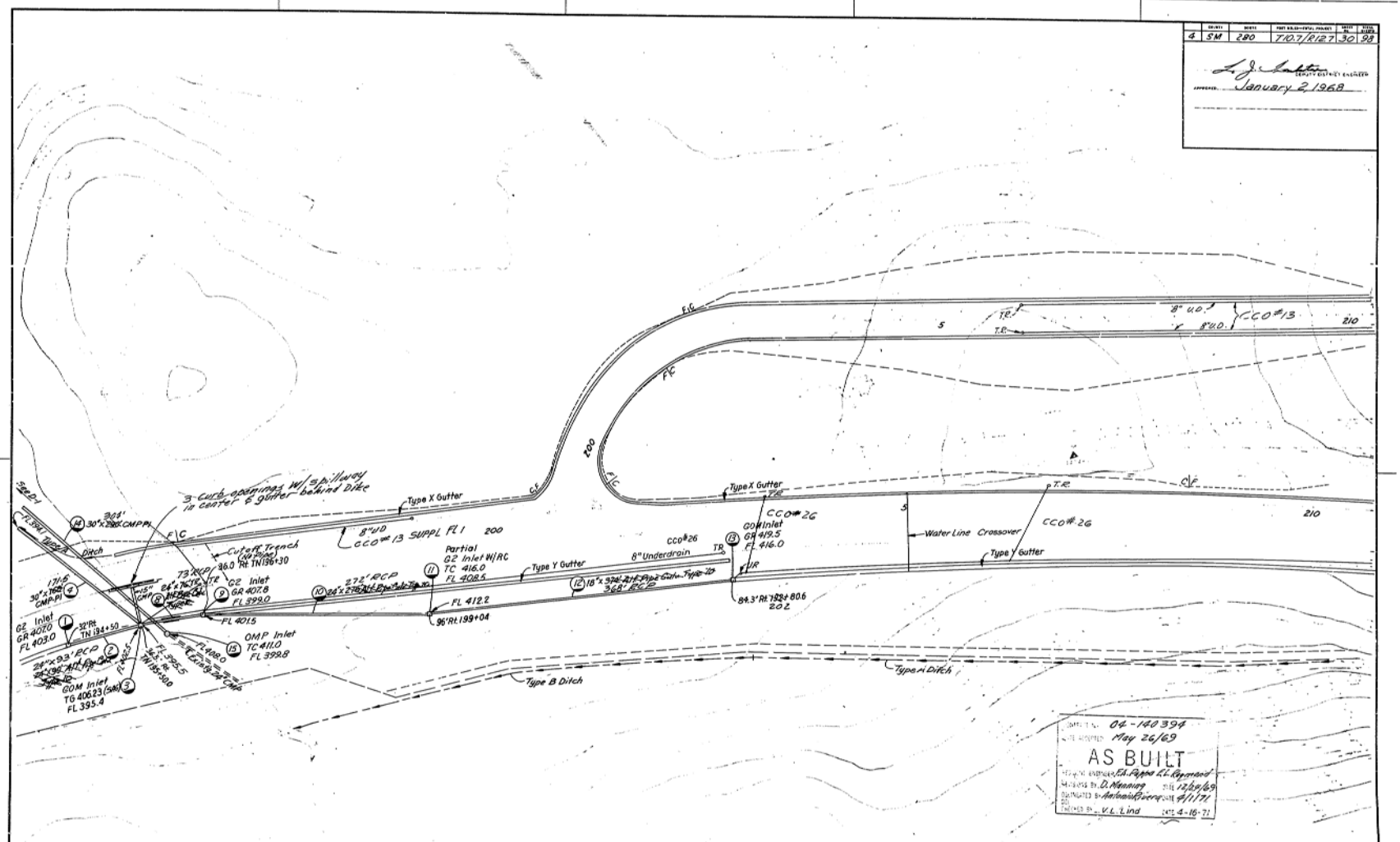
140391

FORM HD-76-PF

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 2/6/71 SIGNATURE D.V. S. Kell TITLE NAO II





DISTRICT	COUNTY	ROUTE	POST MILE—TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
4	SM	280	7.10.7/R12.7	30	98

L. J. Smith
DEPUTY DISTRICT ENGINEER
January 2, 1968

04-140394
SITE APPROVED May 26/69
AS BUILT
REVISION ENGINEER E.A. Pappa L.L. Raymond
RECOMMENDED BY D. Manning DATE 12/29/69
DESIGNATED BY Antonia Rivera DATE 4/1/71
APPROVED BY V.L. Lind DATE 4-16-71

AS BUILT PLANS
Contract No. 04-140394
Date Completed
Document No. 4000 1987

DRAINAGE DETAILS
Scale: 1" = 50'
D-2

30

Project Engineer	Date	Design Engineer	Date	Approval Recommended By	Date

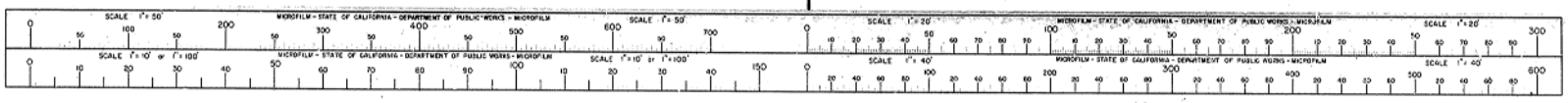
140391

5-2

FORM BH 233A-FF

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 2/6/71 SIGNATURE D.I.S. Kell TITLE MAO II



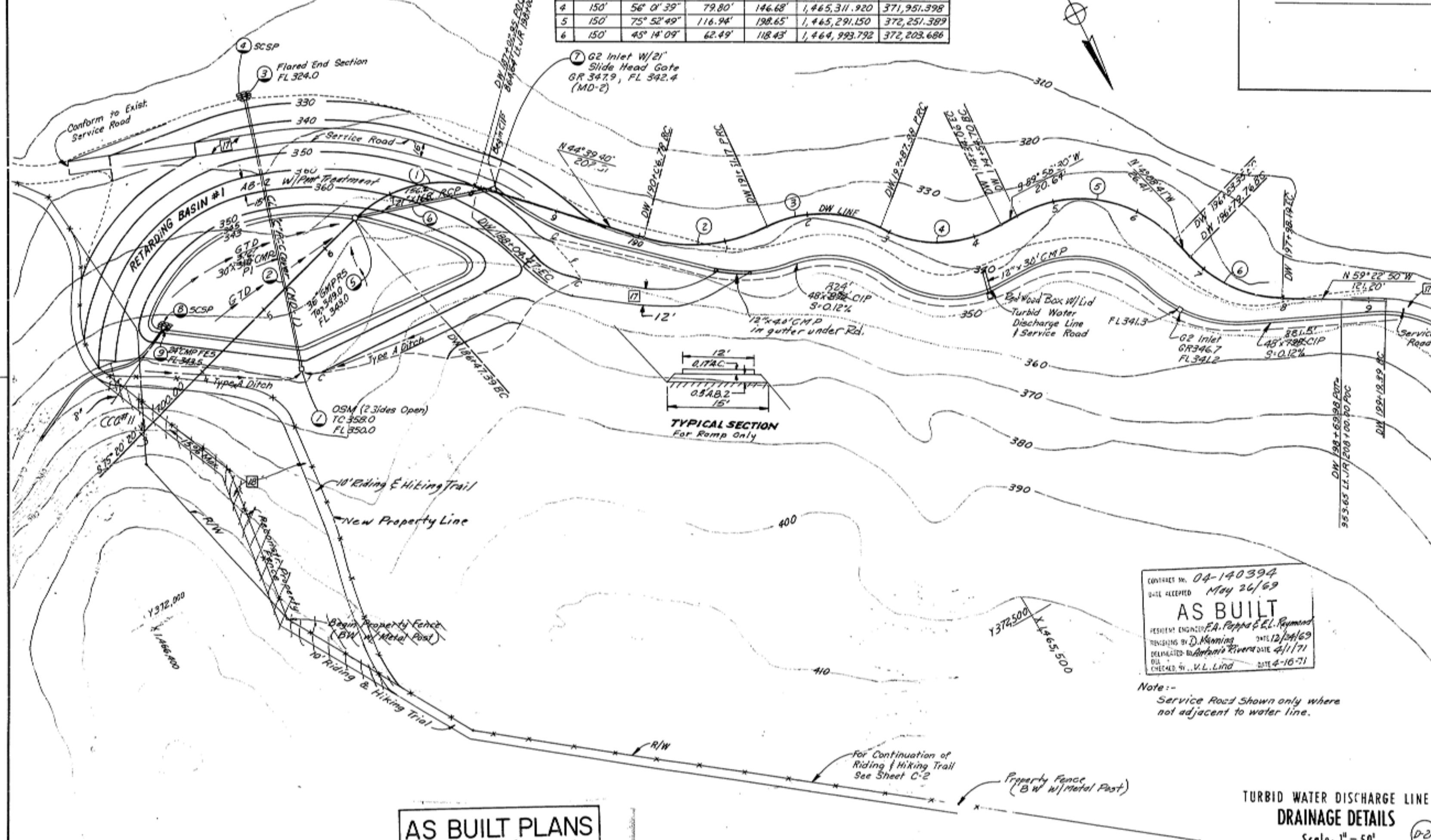
DIST.	COUNTY	ROUTE	POST MILES–TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
4	SM	280	7.10.7/R12.7	31	98

DEPUTY DISTRICT ENGINEER
APPROVED January 2, 1968

31

CURVE ALIGNMENT DATA

No.	Radius	Delta	Tangent	Length	X	Y
1	150'	60° 00'00"	86.60'	157.08'	1,465,927.539	371,872.109
2	200'	41° 21'56"	75.50'	144.39'	1,465,536.386	371,769.988
3	150'	52° 0'45"	73.21'	136.21'	1,465,560.638	372,119.146
4	150'	56° 0'39"	79.80'	146.68'	1,465,311.920	371,951.398
5	150'	75° 52'49"	116.94'	198.65'	1,465,291.150	372,251.389
6	150'	45° 14'09"	62.49'	118.43'	1,464,993.792	372,203.686



CONTRACT No. 04-140394
DATE ACCEPTED May 26/69
AS BUILT
RESIDENT ENGINEER F.A. Poppe & E.L. Raymond
REVISIONS BY D. Manning DATE 12/24/69
DELINEATED BY Antonio Rivera DATE 4/1/71
CHECKED BY V.L. Lind DATE 4-16-71

Note:-
Service Road Shown only where not adjacent to water line.

TURBID WATER DISCHARGE LINE
DRAINAGE DETAILS
Scale: 1" = 50'
D-2A

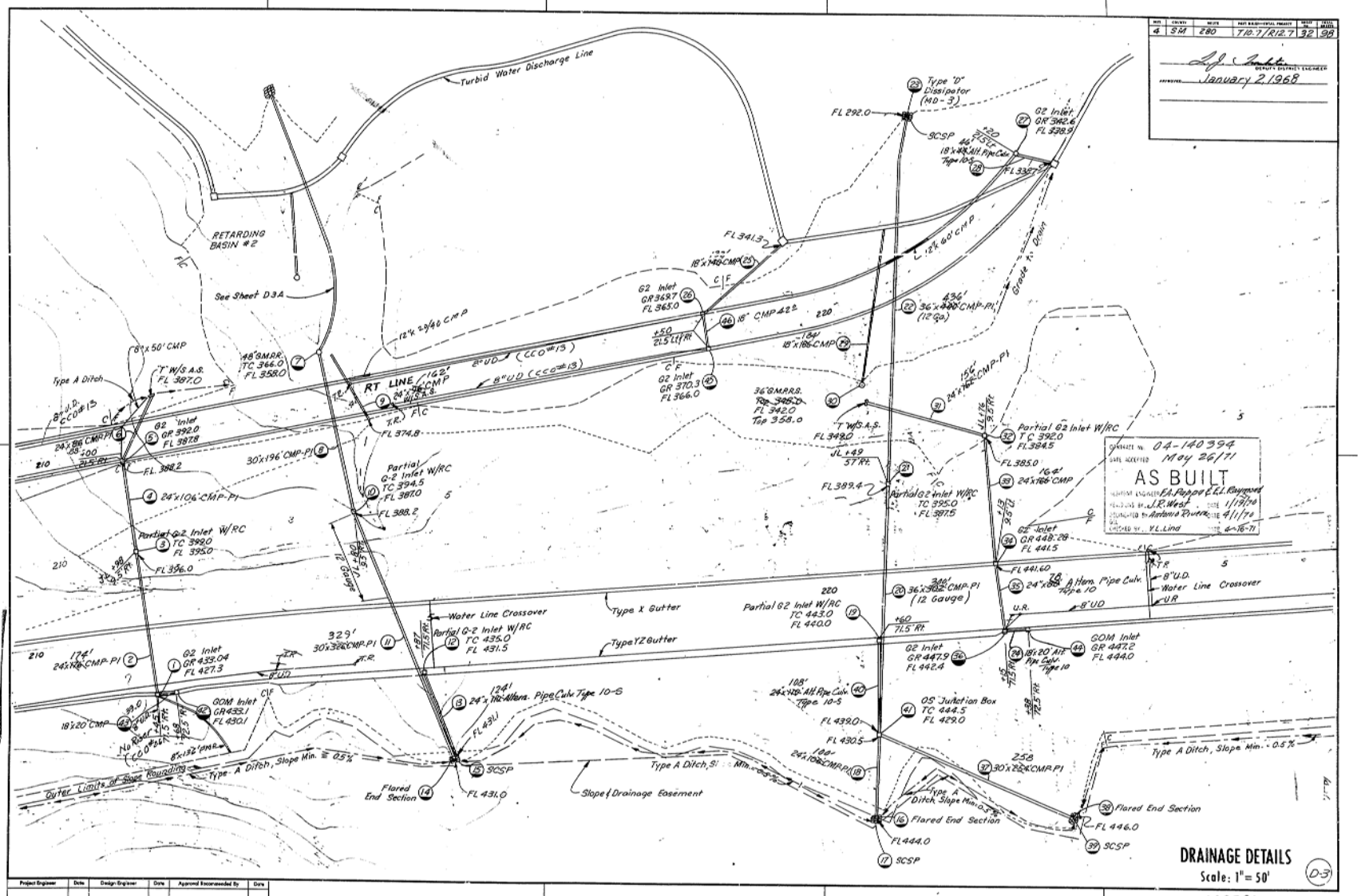
140391

Project Engineer	Date	Design Engineer	Date	Approval Recommended By	Date

AS BUILT PLANS
Contract No. 04-140394
Date Completed
Document No. 40001987

FORM HD-76-PF 2

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.
DATE 7/6/71 SIGNATURE TITLE HAO II



AS BUILT PLANS
Contract No. 04-140394
Date Completed
Document No. 4000419812

32

Project Engineer	Date	Design Engineer	Date	Approved Recommended By	Date

DIST	COUNTY	ROUTE	POST MILE/KILOMETER PREFIX	SHEET NO.	TOTAL SHEETS
4	SM	280	7.10-7/R12.7	32	98

DEPUTY DISTRICT ENGINEER
January 2, 1968

CONTRACT NO. 04-140394
DATE ACCEPTED May 26, 1971

AS BUILT
RESIDENT ENGINEER E.A. Peppe & E.L. Raymond
REVISED BY J.R. West DATE 1/19/72
DRAWING BY Antonio Pineda DATE 4/1/74
CHECKED BY Y.L. Lind DATE 4-16-74

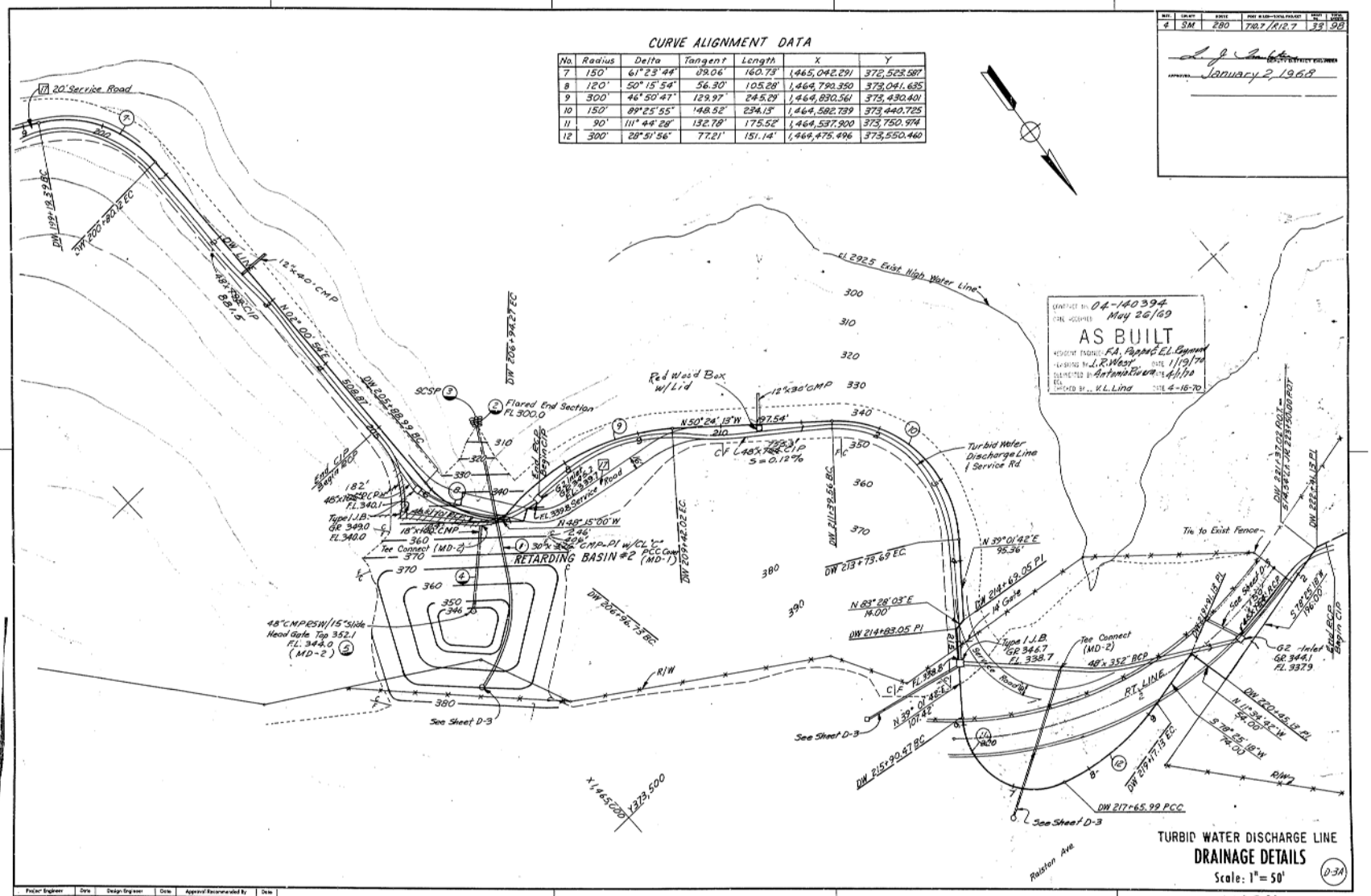
140391

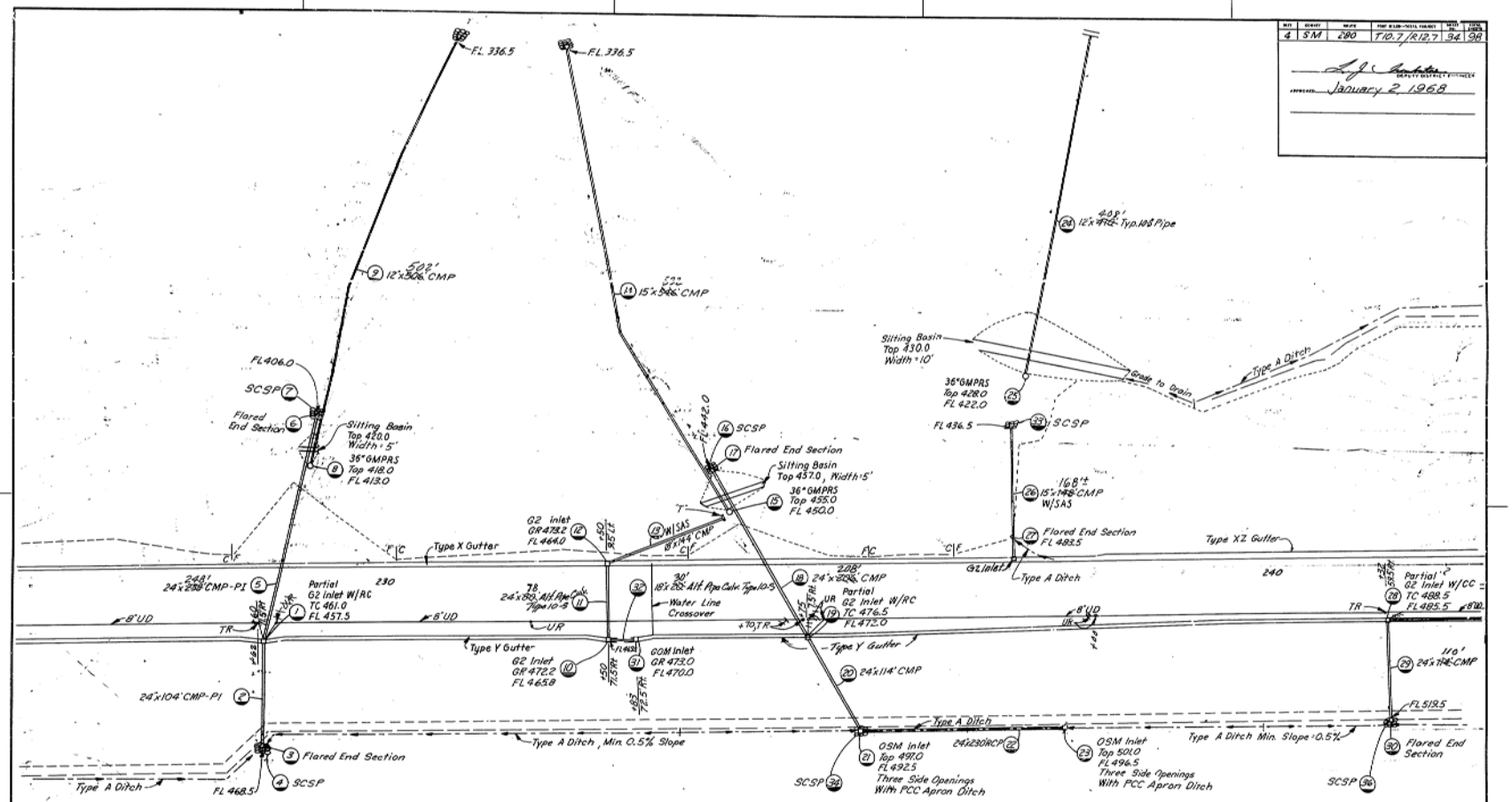
5-3

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 2/16/71 SIGNATURE [signature] TITLE HAO II

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM


CURVE ALIGNMENT DATA
No. | Radius | Delta | Tangent | Length | X | Y
7 | 150' | 61°23'44" | 89.06' | 160.73' | 1,465,042.291 | 372,523.587
8 | 120' | 50°15'54" | 56.30' | 105.28' | 1,464,790.350 | 373,041.635
9 | 300' | 46°50'47" | 129.97' | 245.29' | 1,464,830.561 | 373,430.401
10 | 150' | 89°25'55" | 148.52' | 234.13' | 1,464,582.739 | 373,440.725
11 | 90' | 111°44'28" | 132.78' | 175.52' | 1,464,537.900 | 373,750.974
12 | 300' | 28°51'56" | 77.21' | 151.14' | 1,464,475.496 | 373,550.460
20' Service Road
12"x40' CMP
48"x38" RCP
DW 205+98.92 BC
DW 206+94.27 EC
SCSP
Flared End Section FL 300.0
Red Wood Box w/Lid
12"x30' CMP
N 50° 24' 13" W 97.54'
CF L 48"x76" CMP S = 0.12%
Turbid Water Discharge Line & Service Rd
fl 2925 Exist High Water Line
CONTRACT No. 04-140394
WORK ACCEPTED May 26, 1969
AS BUILT
RESIDENT ENGINEER F.A. Pappas & E.L. Bynum
PREPARED BY J.R. West DATE 1/19/70
SUBMITTED BY Antonio Rivera
APPROVED BY W.L. Lind DATE 4-16-70
Type I.J.B. GR 349.0 FL 340.0
18"x100' CMP
30"x 76' CMP-PI w/CL Y-PCC Conc (MD-1)
Tee Connect (MD-2)
RETARDING BASIN #2
48" CMP PSW/15" Slide Head Gate Top 352.1 FL. 344.0 (MD-2)
See Sheet D-3
DW 206+96.73 BC
DW 211+39.56 BC
DW 213+73.69 EC
N 39° 01' 42" E 95.36'
Tie to Exist Fence
DW 214+63.05 PI
14' Gate
N 83° 28' 03" E 14.00'
Type I.J.B. GR 346.7 FL 338.7
Tee Connect (MD-2) 48"x 352" RCP
G2 Inlet GR 344.1 FL 337.9
DW 215+90.47 EC
DW 217+65.99 PCC
DW 219+17.13 EC
DW 220+45.32 PI
N 11° 34' 42" W 54.00'
S 78° 25' 18" W 146.00'
R/W
Raiston Ave.
TURBID WATER DISCHARGE LINE
DRAINAGE DETAILS
Scale: 1" = 50'
D-3A
AS BUILT PLANS
Contract No. 04-140394
Date Completed
Document No. 140391
33
140391
I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.
DATE 2/6/71 SIGNATURE TITLE



DIST	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
4	SM	280	T10.7/R12.7	34	98

January 2, 1968

CONTRACT NO. 04-140394
DATE ACCEPTED May 26, 1969

AS BUILT

RESIDENT ENGINEER T.A. Pappe & E.L. Raymond
ASSISTED BY G.R. West DATE 1/19/71
DELINEATED BY Andonio Rivera DATE 4/1/71
CHECKED BY V.L. Lind DATE 4-16-71

AS BUILT PLANS
Contract No. 04-140394
Date Completed
Document No. 40001987

Project Engineer	Date	Design Engineer	Date	Approval Recommended By	Date

DRAINAGE DETAILS

Scale: 1" = 50'

D-41

140391

S-4

34

I HEREBY ATTEST THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 7/6/71 SIGNATURE [signature] TITLE HAO II

CURVE ALIGNMENT DATA

No	Radius	Delta	Tangent	Length	X	Y
13	200'	33°24'02"	60.00'	116.59'	1,464,121.811	374,060.470
14	200'	29°13'44"	52.15'	102.03'	1,463,787.207	373,839.191
15	200'	33°00'44"	59.27'	115.23'	1,463,866.999	374,239.783
16	200'	26°52'02"	47.77'	93.78'	1,463,442.949	374,846.966
17	200'	74°51'52"	153.09'	261.33'	1,463,047.671	374,795.688

DIST	COUNTY	ROUTE	POST MILE/KILOMETER PREFIX	SHEET NO.	TOTAL SHEETS
4	SM	280	7.0-7 / R12.7	35	98

DEPUTY DISTRICT ENGINEER

APPROVED January 2, 1968

El 292.5 Exist. High Water Line

Install GP-M Inlet To Exist. 4'x4' RCB GR 297.5 FL 292.3 (MD-4)

FL 293.0

30'x282' CMP W/PI

Reconstruct Existing Property Fence

Riding & Hiking Trail

DW 232+90.80 PC

Skyline Blvd

Rte. 35

DW 238+65.25 EC

DW 236+63.92 PRC

Turbid Water Discharge Line Service Rd

Service Road 17

Tee Connect (MD-2)

G2 Inlet Gr 341.4 FL 335.9

DW 225+73.29 EC

DW 224+75.26 BC

N 34°44'36"W 419.71'

N 34°02'24"W 95.86'

8'x166' CMP

"DW" LINE

48" CIP RCP, S=0.12%

N 35°40'46"W 219.34'

17"x40' W/ Elbow

Begin CIP End RCP

614.7' 350 48"x82" CIP S=0.12%

Std "L" BW W/ Debris Rack Top 342.0 FL 336.8

G2 Inlet Gr 342.0 FL 336.9

8'x68' PMP MD

PMD (MD-1)

30"x262' CMP-PI W/CL "C" PCCorner

8'x24' CMP

SCSP

48" CMP Riser Top 343.0 FL 332.2

18" RCP

24"x34' CMP W/PI

Type A Ditch

OSM Inlet Gr. 350.0 FL 345.0

OSM Inlet Gr. 349.5 ± FL 345.5

RETARDING BASIN #3

15" CMP Flared End Section FL 396.5

DW 228+71.09 PI

DW 227+75.23 EC

DW 226+60.00 BC

DW 225+10.14 BC

DW 224+44.26 EC

DW 223+28.27 BC

DW 222+41.13 PI

Ralston Ave

Service Road 17

15"x 30' CMP

12"x 34' CMP

14' Gate

48"x 76" CIP S=0.12%

681.5'

N 37°49'24"W 30.40'

N 67°10'08"W 82.71'

DW 221+37.00 POT 514.34 Lt. Jr 223+50.00 POT

Begin CIP End RCP

See Sheet D-4

R/W

Y 374,500 X 1,464,000

See Sheet D-4

CONTRACT No. 04-140394

DATE ACCEPTED May 26, 1969

AS BUILT

RESIDENT ENGINEER F.A. Hoppe / E.L. Raymond

REVISIONS BY J.C. West DATE 1/19/70

DELINEATED BY Antonio Rivera DATE 4/1/71

CHECKED BY V.L. Lind DATE 4-16-71

TURBID WATER DISCHARGE LINE
DRAINAGE DETAILS

Scale: 1" = 50'

(04A)

AS BUILT PLANS
Contract No. 04-140394
Date Completed
Document No. 140391

35

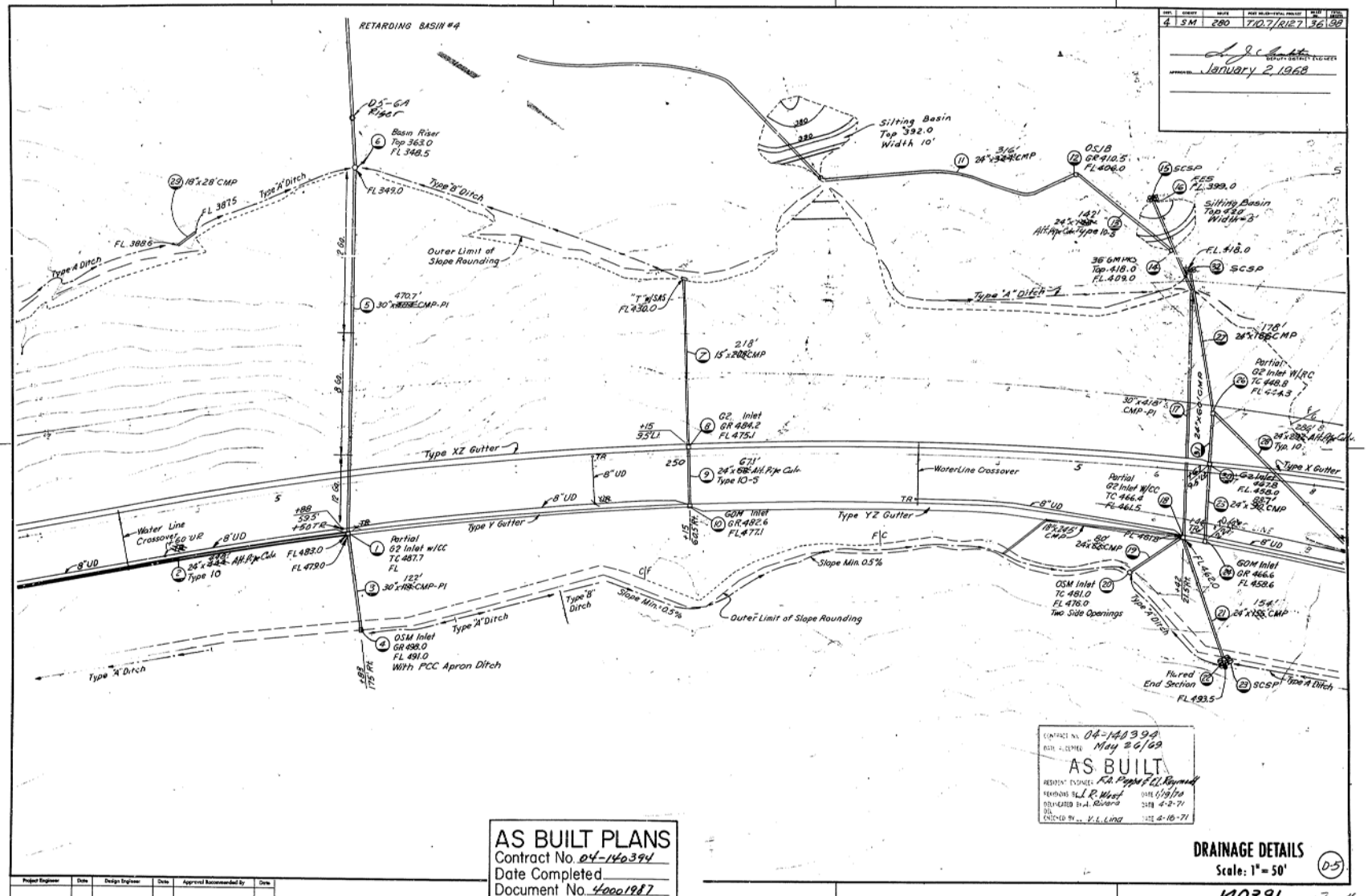
Project Engineer	Date	Design Engineer	Date	Approved/Recommended By	Date

140391

FORM HD-76-PF 4

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 7/6/71 SIGNATURE D.I.S.K.H. TITLE M.A.O. II



DIST.	COUNTY	ROUTE	POST MILE/EFFECTIVE PROJECT	SHEET NO.	TOTAL SHEETS
4	SM	280	7.10.7/R12.7	36	50

APPROVED: January 2, 1968

CONTRACT NO. 04-140394
DATE ACCEPTED May 26/69

AS BUILT
RESIDENT ENGINEER R.A. Pupp & E.L. Raymond
REVISIONS BY J. R. West DATE 6/19/70
DELINEATED BY A. Rivera DATE 4-2-71
OK
CHECKED BY ... V. L. Lind DATE 4-16-71

AS BUILT PLANS
Contract No. 04-140394
Date Completed
Document No. 40001987

Project Engineer	Date	Design Engineer	Date	Approval Recommended By	Date

36

DRAINAGE DETAILS
Scale: 1" = 50'
D-5

140391

S-5

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION OF THE DIRECTOR OF PUBLIC WORKS.

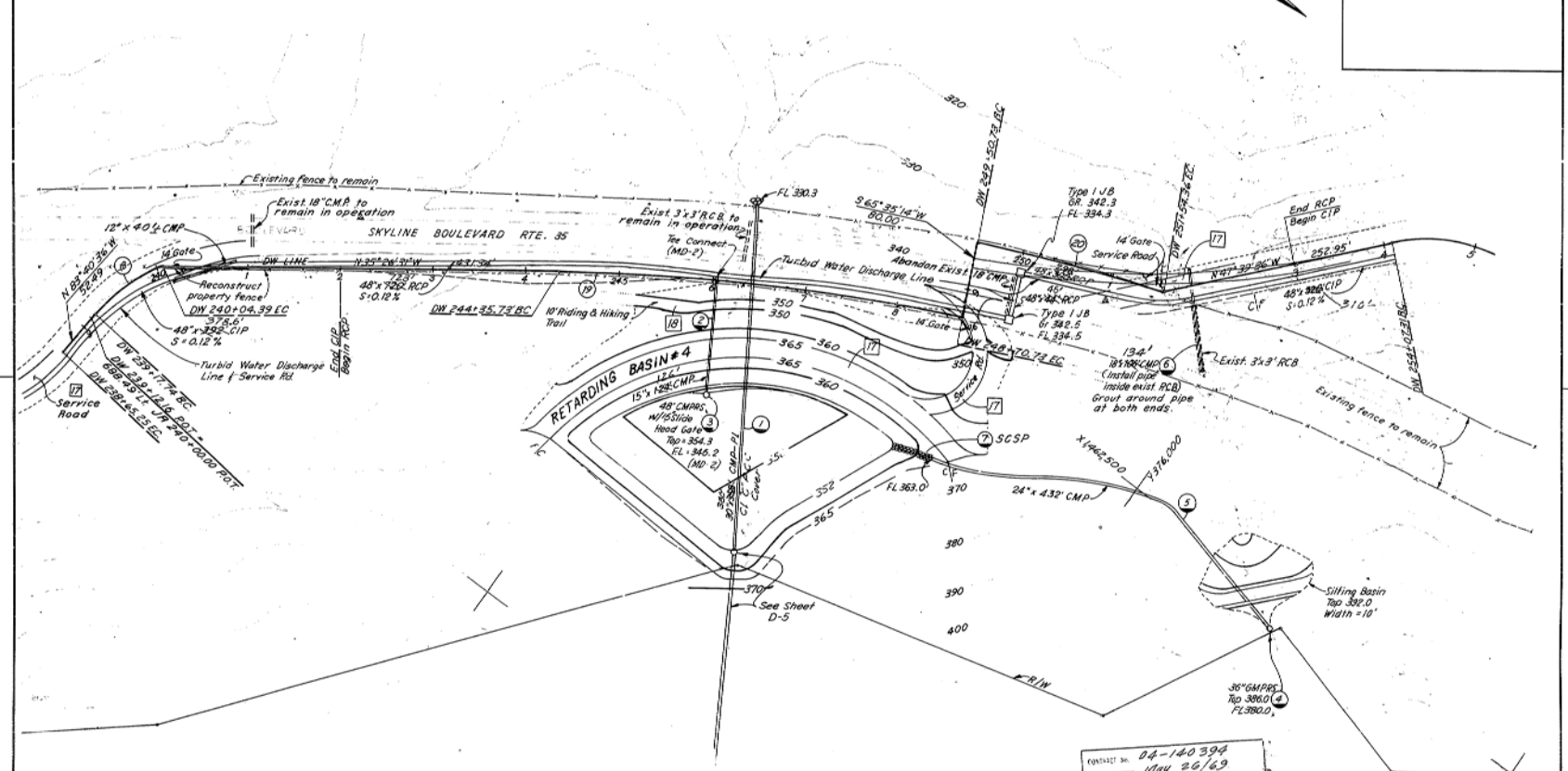
DATE 7/6/71 SIGNATURE [signature] TITLE NAO II

CURVE ALIGNMENT DATA

No.	Radius	Delta	Tangent	Length	X	Y
18	200'	24°49'28"	44.02'	86.65'	1,463,039.556	375,189.035
19	2,259.80'	11°01'45"	218.17'	435.00'	1,464,527.047	376,679.187
20	2,339.80'	4°59'11"	101.88'	203.63'	1,464,527.047	376,679.687

DIST.	COUNTY	ROUTE	POST MILES—TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
4	SM	280	7.10.7/R12.7	37	98

L. J. Sachs
DEPUTY DISTRICT ENGINEER
APPROVED January 2, 1968



AS BUILT PLANS
Contract No. 04-140394
Date Completed
Document No. 4000 1987

CONTRACT No. 04-140394
DATE ACCEPTED May 26/69
AS BUILT
APPROVED ENGINEER: R.S. Hoppe & E.L. Raymond
RE-DRAWN BY: J.P. Wiest 1/17/72
RECEIVED BY: Antonio Rivera 4/2/71
DATE: V.L. Lind 4-16-71

TURBID WATER DISCHARGE LINE
DRAINAGE DETAILS
Scale: 1" = 50'
(U-34)

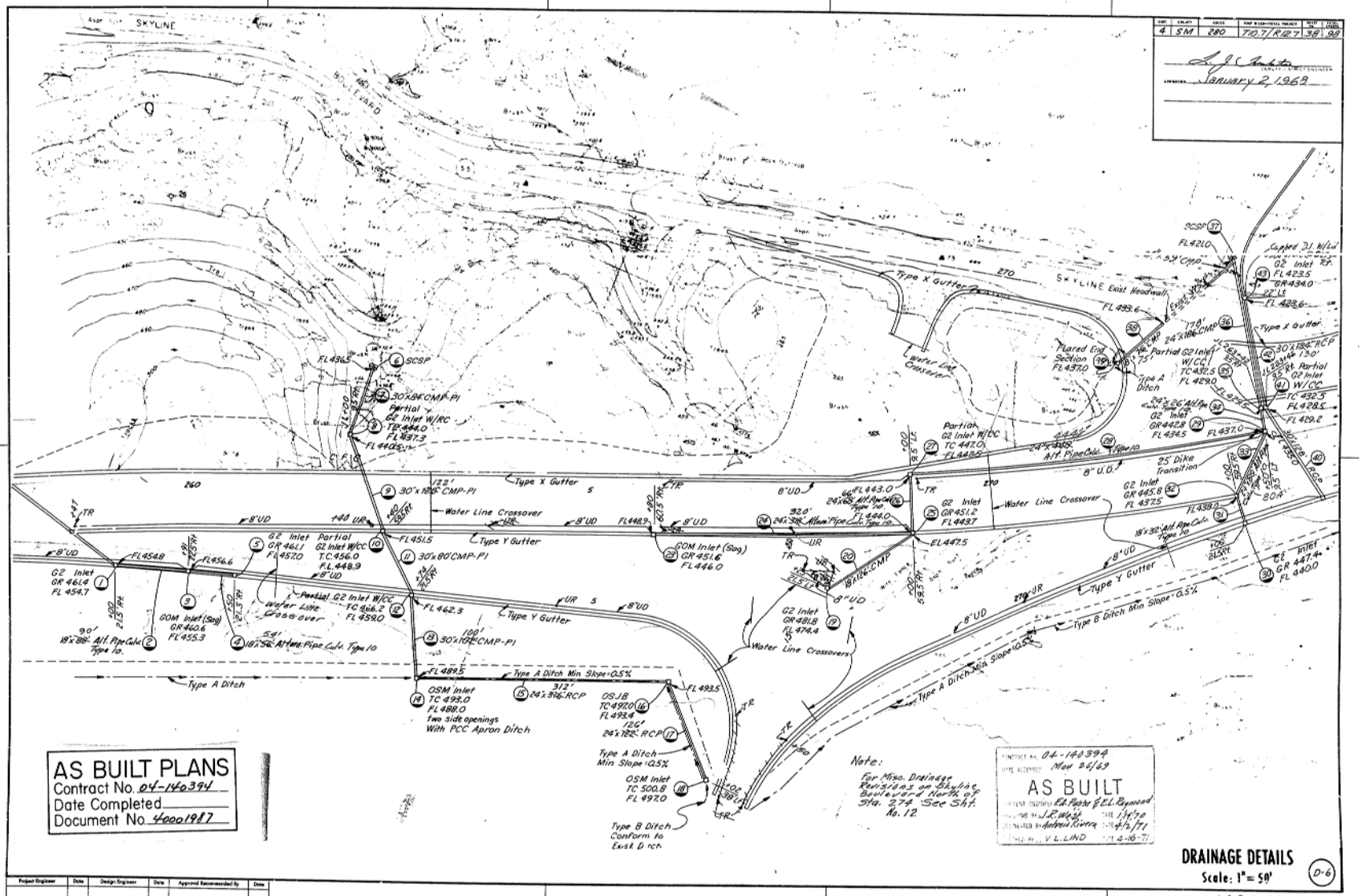
37

140391

FORM HD-76-PF 5

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 2/6/71 SIGNATURE J.I.S. Kaff TITLE M.A.O. II



DIST	COUNTY	ROUTE	POST MILE-TOTAL PROJECT	SHEET	TOTAL SHEETS
4	SM	280	10.7/R27.38	38	98

January 2, 1968

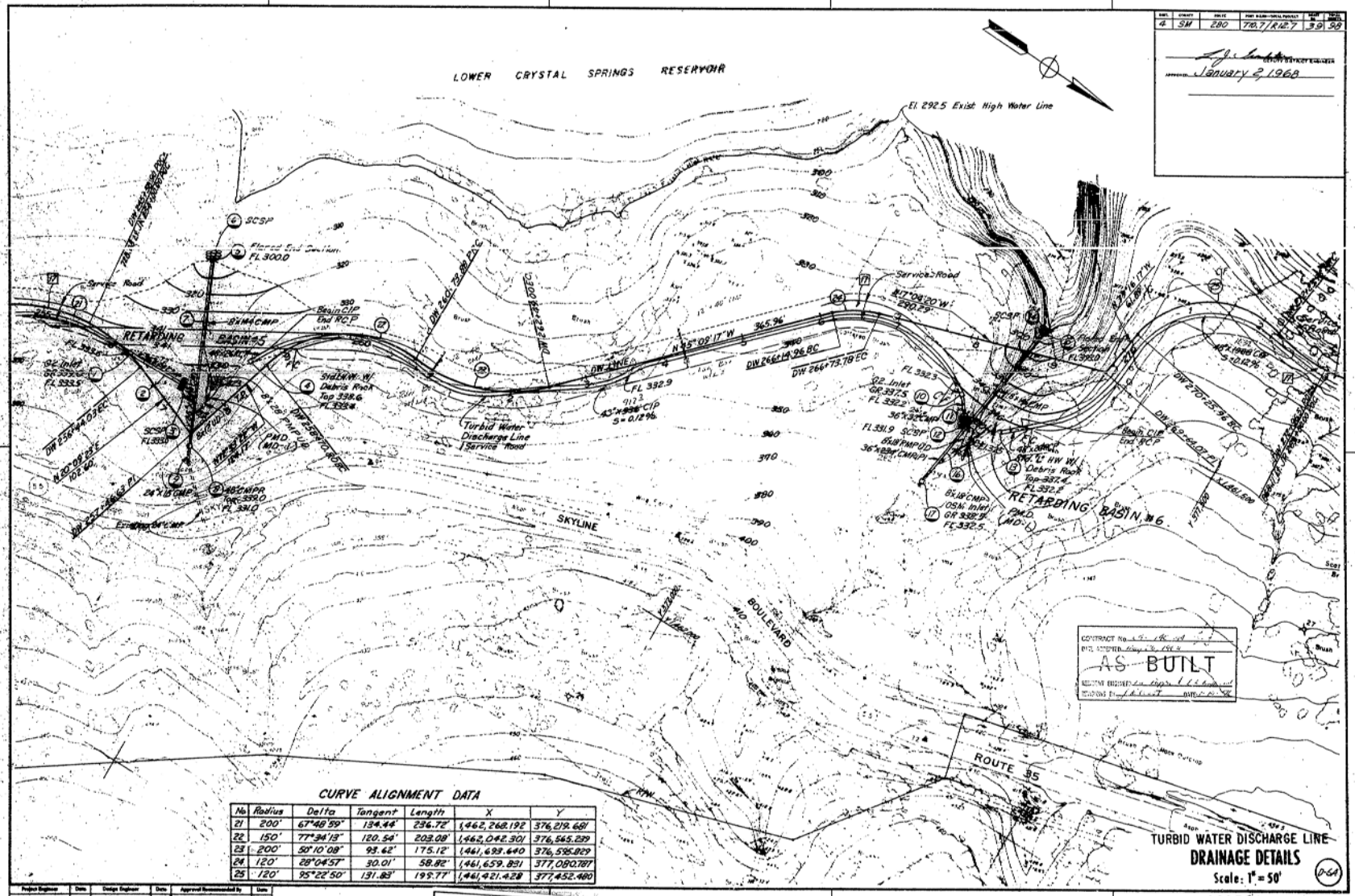
38

5-6

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 2/6/71 SIGNATURE W. S. Kell TITLE HAD II

MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM



CURVE ALIGNMENT DATA

No.	Radius	Delta	Tangent	Length	X	Y
21	200'	67°48'59"	134.44'	236.72'	1,462,268.192	376,219.681
22	150'	77°34'13"	120.54'	203.08'	1,462,042.301	376,565.239
23	200'	50°10'08"	93.62'	175.12'	1,461,693.640	376,585.829
24	120'	28°04'57"	30.01'	58.82'	1,461,659.831	377,090.781
25	120'	95°22'50"	131.83'	199.77'	1,461,421.428	377,452.460

39

140391

AS BUILT PLANS
Contract No. 04-140394
Date Completed
Document No. 4000987

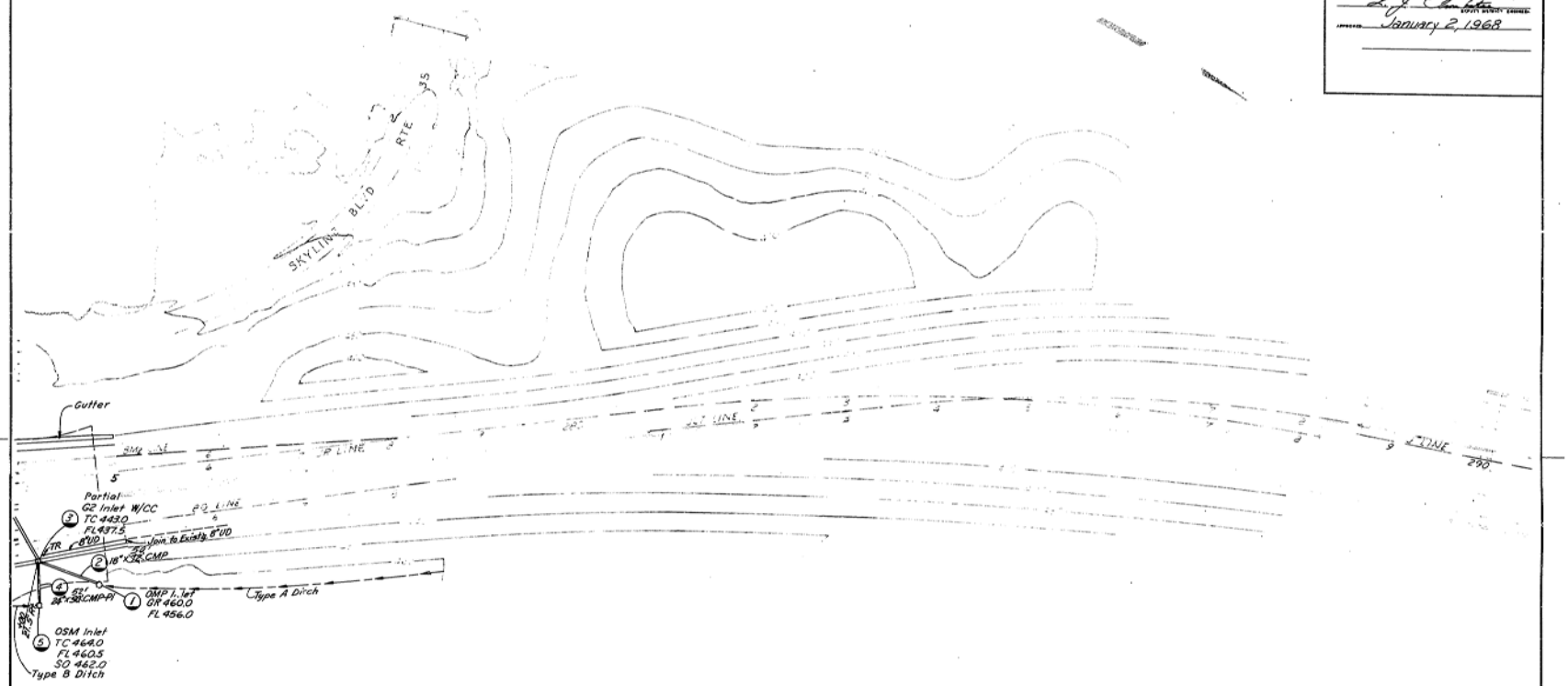
I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 2/16/71 SIGNATURE [illegible] TITLE NAC II

FORM HD-76-PF 6

DIST.	COUNTY	ROUTE	POST MILES: TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
4	SM	280	T10.7/R18.7	40	99

Approved January 2, 1968



AS BUILT PLANS
Contract No. 04-140394
Date Completed
Document No. 40001987

CONTRACT NO. 04-140394
DATE ACCEPTED May 26/69
AS BUILT
RESIDENT ENGINEER F.A. Peppa & E.L. Raymond
REVISIONS BY J.R. West DATE 1/19/70
DESIGNATED BY Antonio Buenaventura 4/2/71
DE
CHECKED BY Y.L. Lind DATE 4-16-71

DRAINAGE DETAILS

Scale: 1" = 50'

D-7

40

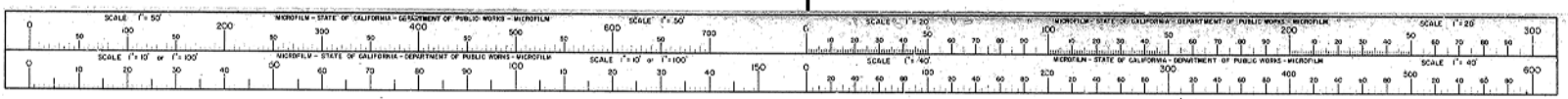
Project Engineer	Date	Design Engineer	Date	Approved/Recommended By	Date

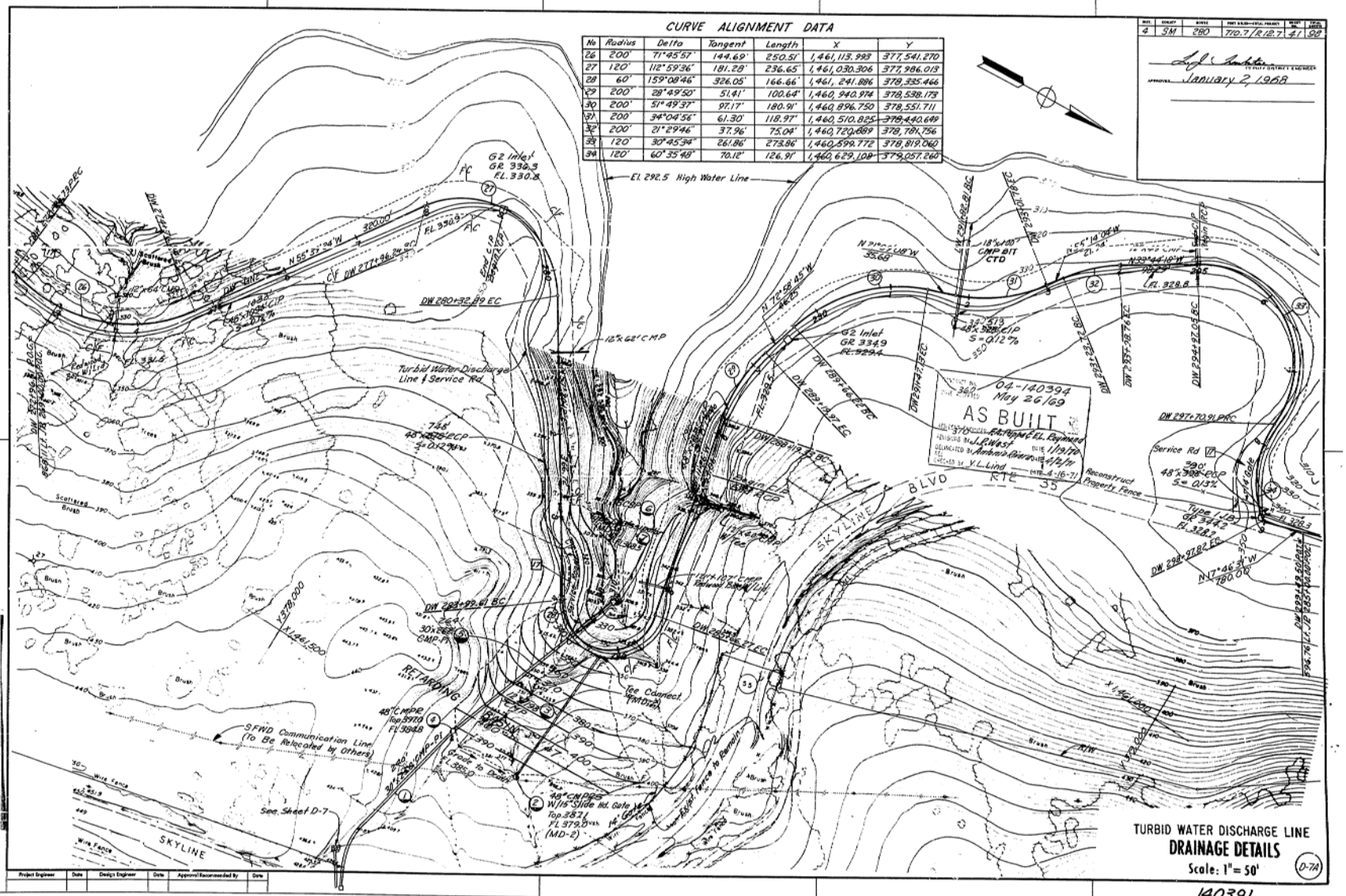
140391

S-7

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 7/6/71 SIGNATURE D.I.S. Kell TITLE HAO II





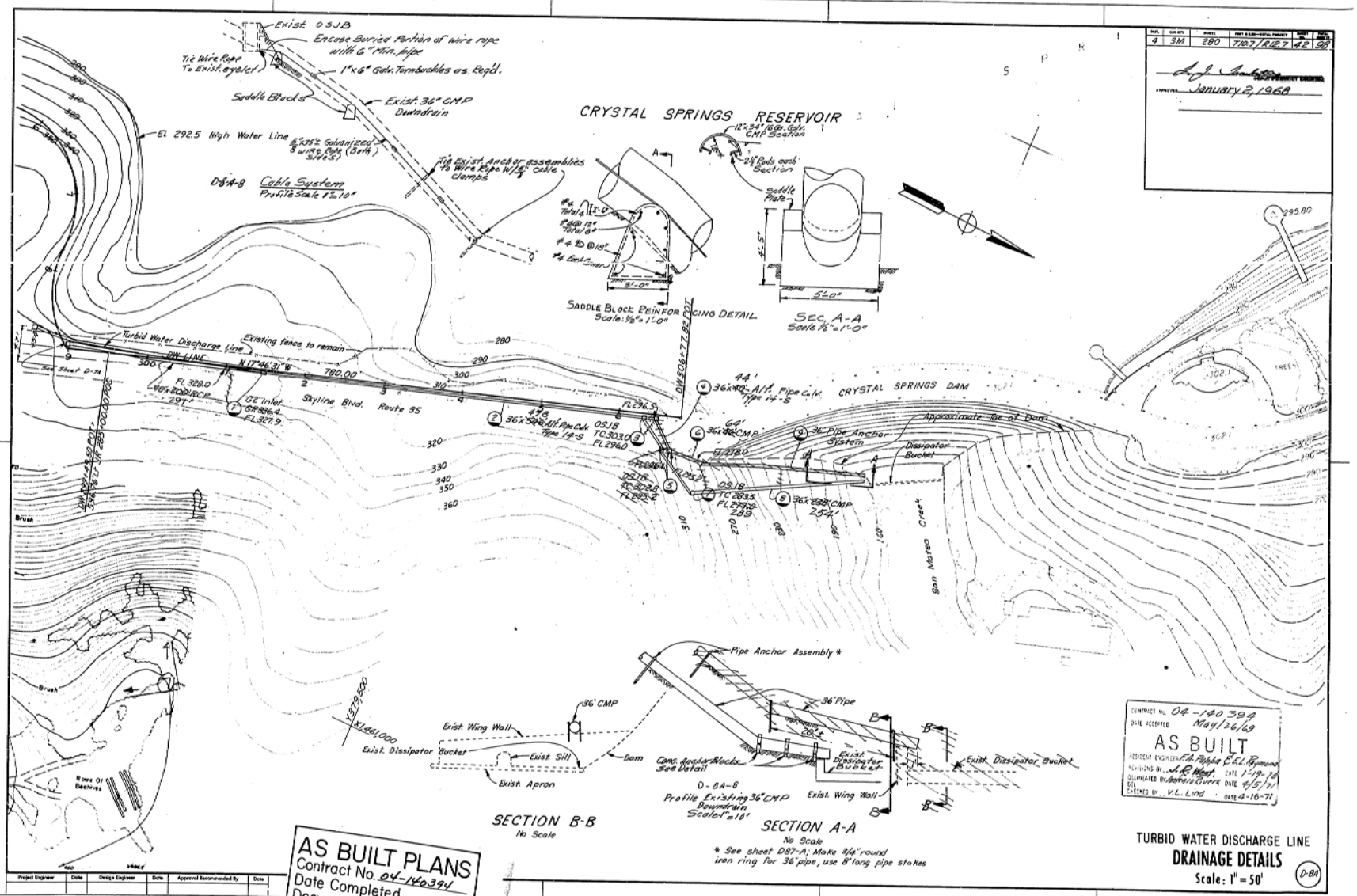
AS BUILT PLANS
Contract No. 04-140394
Date Completed
Document No. 4 May 1967

41

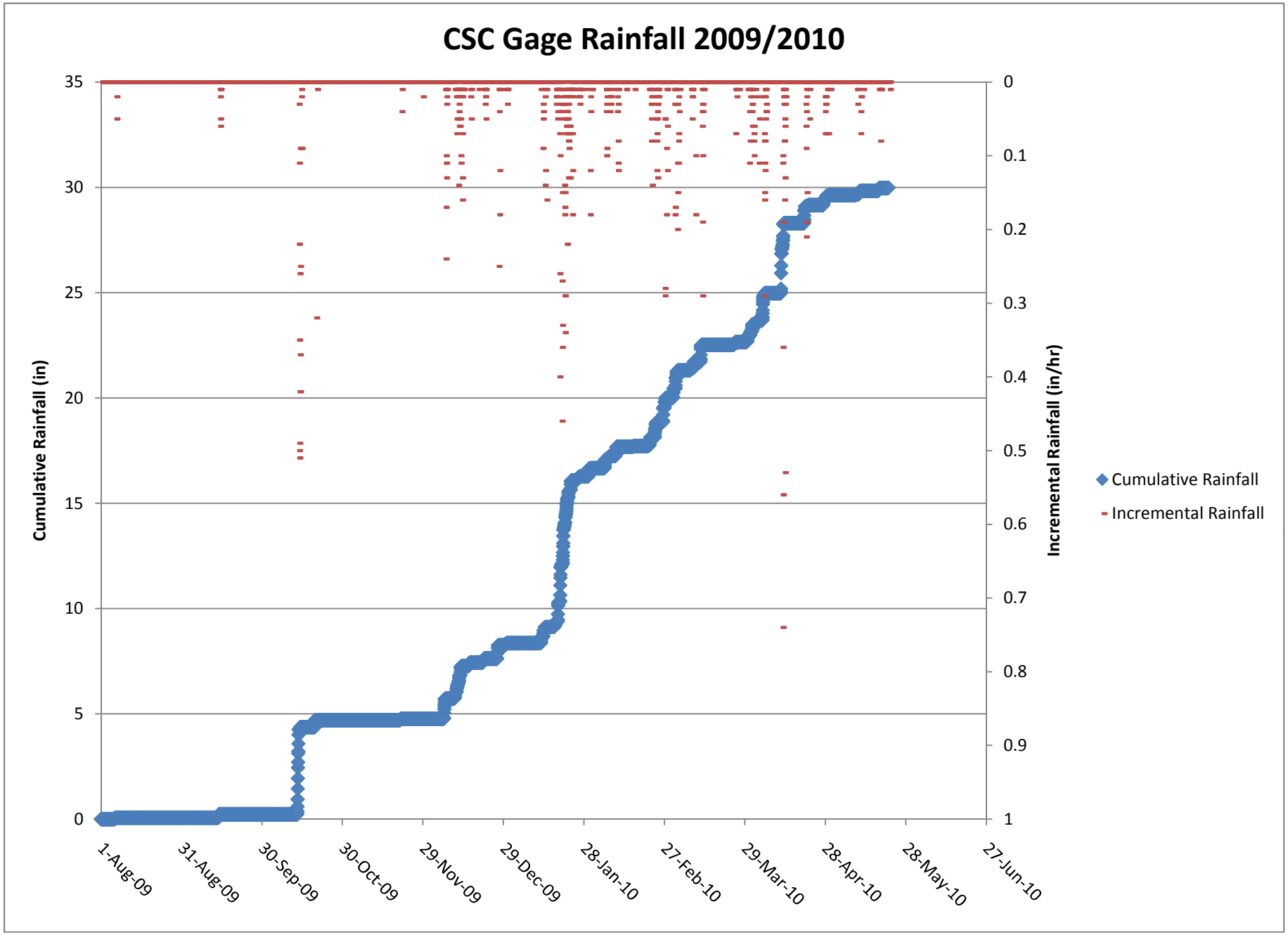
140391

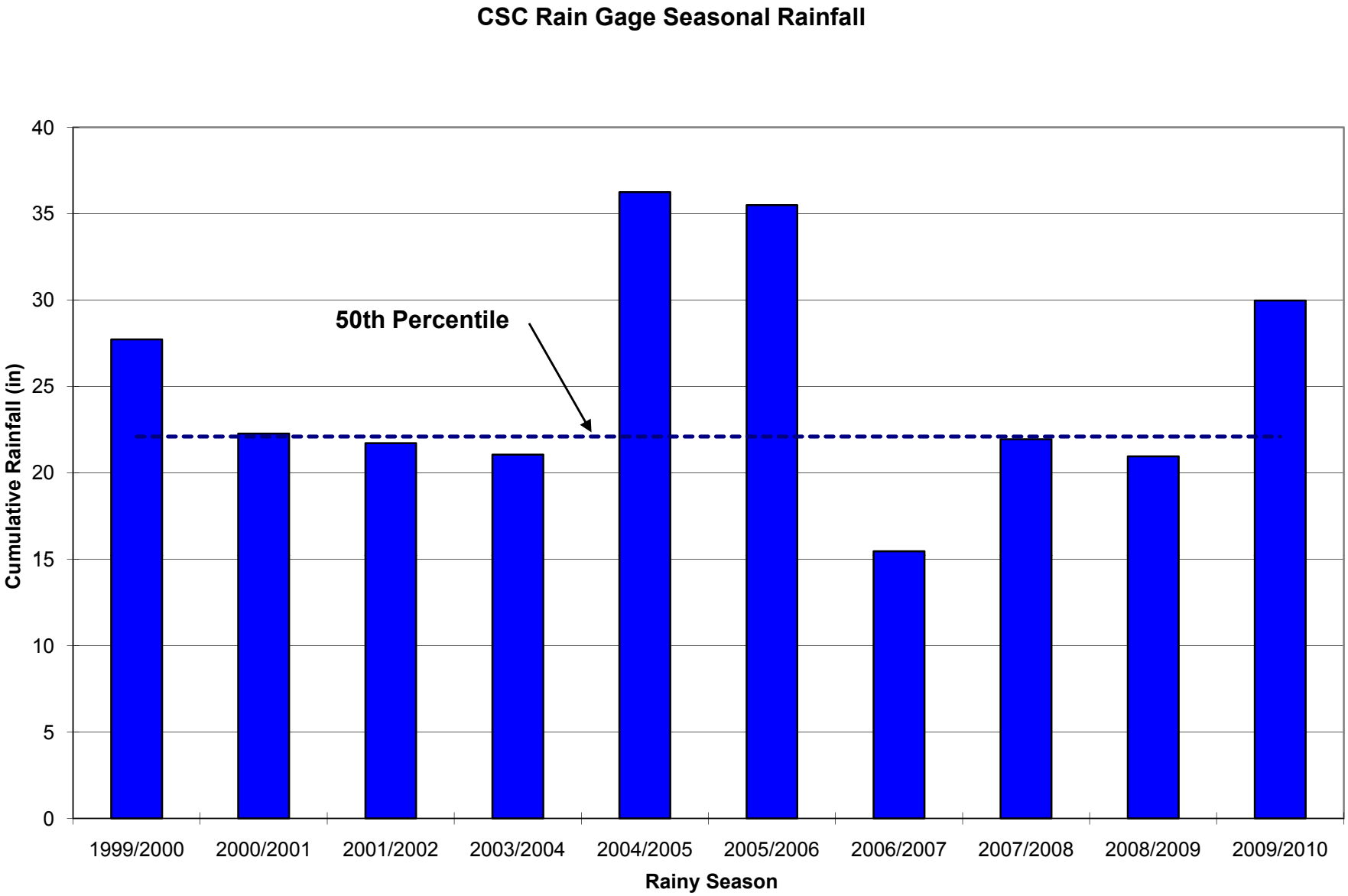
I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 7/6/71 SIGNATURE Jr. S. Kell TITLE NAO II


CRYSTAL SPRINGS RESERVOIR
CRYSTAL SPRINGS DAM
Exist. O.S.J.B.
Encase Buried Portion of wire rope with 6" Min. pipe
Tie Wire Rope To Exist. eyelet
1"x6" Galv. Turnbuckles as Req'd.
Saddle Blocks
Exist. 36" CMP Downdrain
El. 292.5 High Water Line
6"x15'± Galvanized 8 wire Rods (Each Side)
Tie Exist. anchor assemblies to Wire Rope W/1/2" cable clamps
D-8A-8 Cable System
Profile Scale 1"=10'
12"x24"x16 Ga. Galv. CMP Section
2½" Rods each Section
Saddle Plate
SADDLE BLOCK REINFORCING DETAIL
Scale: ½"=1'-0"
SEC. A-A
Scale ½"=1'-0"
Turbid Water Discharge Line
Existing fence to remain
CW LINE
N 17°46'31" W
780.00'
Skyline Blvd. Route 35
44' 36"x48" Alt. Pipe Culv. Type 14-S
64' 36"x48" CMP
36" Pipe Anchor System
Approximate Toe of Dam
Dissipator Bucket
254' 36"x48" CMP
San Mateo Creek
Pipe Anchor Assembly *
36" CMP
36" Pipe
Exist. Wing Wall
Exist. Dissipator Bucket
Exist. Sill
Dam
Conc. Anchor Blocks See Detail
Exist. Apron
D-8A-B
Profile Existing 36" CMP Downdrain
Scale 1"=10'
SECTION B-B
No Scale
SECTION A-A
No Scale
* See sheet D87-A; Make 3/4" round iron ring for 36" pipe, use 8' long pipe stakes
TURBID WATER DISCHARGE LINE
DRAINAGE DETAILS
Scale: 1"=50'
D-84
AS BUILT
AS BUILT PLANS
Contract No. 04-140394
Date Completed
Document No. 4000198?
CONTRACT No. 04-140394
DATE ACCEPTED May 26, 69
ASSISTANT ENGINEER F.A. Pfeifer E.E.L. Raymond
DRAWING BY J.R. West DATE 1-19-70
DESIGNED BY Antonia Rivera DATE 4/5/71
CHECKED BY V.L. Lind DATE 4-16-71
Project Engineer | Date | Design Engineer | Date | Approved Recommended By | Date
42
140391
FORM HD-76-PP 8
I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.
DATE 7/6/71 SIGNATURE Jo I. B. Koff TITLE HAO II
MICROFILM - STATE OF CALIFORNIA - DEPARTMENT OF PUBLIC WORKS - MICROFILM

APPENDIX B
STREAM, PIEZOMETER & RAINFALL GAGE DATA

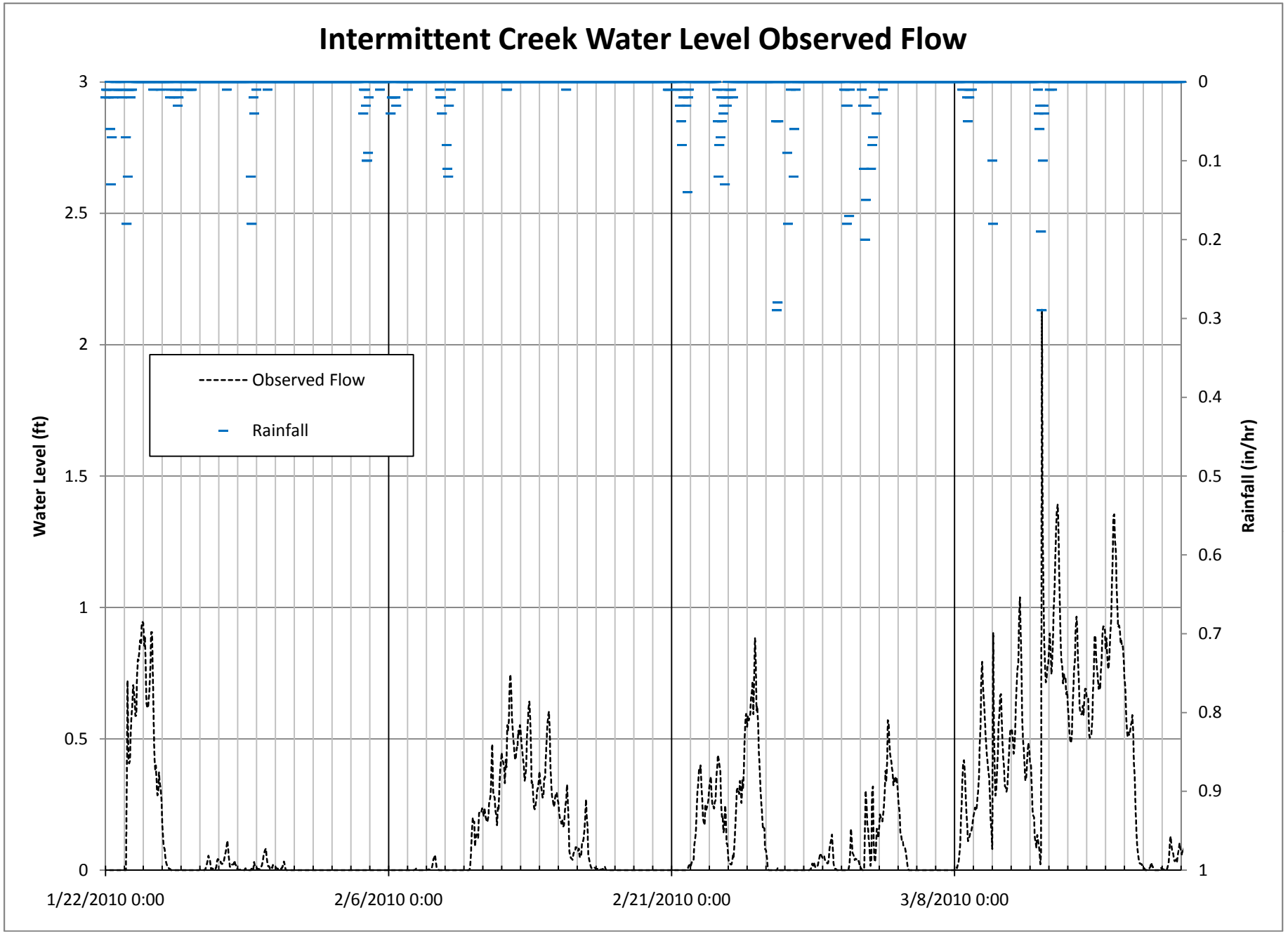

CSC Gage Rainfall 2009/2010
Cumulative Rainfall (in)
Incremental Rainfall (in/hr)
35
30
25
20
15
10
5
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1-Aug-09
31-Aug-09
30-Sep-09
30-Oct-09
29-Nov-09
29-Dec-09
28-Jan-10
27-Feb-10
29-Mar-10
28-Apr-10
28-May-10
27-Jun-10
Cumulative Rainfall
Incremental Rainfall


CSC Rain Gage Seasonal Rainfall
Cumulative Rainfall (in)
40
35
30
25
20
15
10
5
0
50th Percentile
1999/2000
2000/2001
2001/2002
2003/2004
2004/2005
2005/2006
2006/2007
2007/2008
2008/2009
2009/2010
Rainy Season

CUMULATIVE RAINFALL SUMMARY

Rainy Season	Cumu	50th Per
1999/2000	27.72	22.105
2000/2001	22.27	22.105
2001/2002	21.72	22.105
2003/2004	21.06	22.105
2004/2005	36.25	22.105
2005/2006	35.5	22.105
2006/2007	15.46	22.105
2007/2008	21.94	22.105
2008/2009	20.96	22.105
2009/2010	29.98	22.105

Average:	25.286
Median	22.105


Intermittent Creek Water Level Observed Flow
Water Level (ft)
Rainfall (in/hr)
Observed Flow
Rainfall
3
2.5
2
1.5
1
0.5
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1/22/2010 0:00
2/6/2010 0:00
2/21/2010 0:00
3/8/2010 0:00

Boat Ramp Wetland Piezometers			
	Depth to Ground Water (ft)		
Date	B1	B2	B3
2/25/2010	1.25	0.8	1.05
3/4/2010	1	0.75	0.9
3/19/2010	1.3	0.8	1.2
3/26/2010	1.4	0.85	1.3
4/16/2010	1.4	0.8	1
4/30/2010	1.5	0.85	1.3
5/7/2010	1.6	0.95	1.5
5/28/2010	1.6	0.9	1.4
6/25/2010	3.25	3	2.85

*ND - Non Detect - Ground water lower than Piezo

Year	Drawdown (in/day)		
2010	0.71	0.90	0.62
Average	0.71	0.90	0.62

Total Average 0.74

APPENDIX C
NRCS SOIL DATA


122° 21' 25"
122° 20' 49"
37° 31' 14"
37° 30' 55"
37° 30' 54"
556900
557000
557100
557200
557300
557400
557500
557600
557700
4152800
4152700
4152600
4152500
4152400
4152300
Monticello Rd
Yorktown Rd
Lexington Ave
132
113
124
120
Map Scale: 1:4,300 if printed on A size (8.5" x 11") sheet.
N
Meters
0 50 100 200 300
Feet
0 200 400 800 1,200

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:4,300 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Mateo County, Eastern Part, and San Francisco County, California
Survey Area Data: Version 6, Mar 13, 2008

Date(s) aerial images were photographed: 6/12/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — San Mateo County, Eastern Part, and San Francisco County, California				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
113	Fagan loam, 15 to 50 percent slopes	C	22.0	48.2%
120	Obispo clay, 15 to 30 percent slopes	D	12.5	27.5%
124	Orthents, cut and fill-Urban land complex, 5 to 75 percent slopes	D	10.8	23.6%
132	Urban land-Orthents, cut and fill complex, 0 to 5 percent slopes	D	0.3	0.6%
Totals for Area of Interest			**45.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower


122° 21' 25"
122° 20' 49"
37° 31' 14"
37° 30' 55"
37° 30' 54"
556900
557000
557100
557200
557300
557400
557500
557600
557700
4152800
4152700
4152600
4152500
4152400
4152300
Monticello Rd
Yorktown Rd
Lexington Ave
132
113
124
120
Map Scale: 1:4,300 if printed on A size (8.5" x 11") sheet.
N
Meters
0 50 100 200 300
Feet
0 200 400 800 1,200

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- <= 0
- > 0 AND <= 0.91
- > 0.91 AND <= 2.7452
- Not rated or not available

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:4,300 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Mateo County, Eastern Part, and San Francisco County, California
Survey Area Data: Version 6, Mar 13, 2008

Date(s) aerial images were photographed: 6/12/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Saturated Hydraulic Conductivity (Ksat)

Saturated Hydraulic Conductivity (Ksat)— Summary by Map Unit — San Mateo County, Eastern Part, and San Francisco County, California				
Map unit symbol	**Map unit name**	**Rating (micrometers per second)**	**Acres in AOI**	**Percent of AOI**
113	Fagan loam, 15 to 50 percent slopes	2.7452	22.0	48.2%
120	Obispo clay, 15 to 30 percent slopes	0.9100	12.5	27.5%
124	Orthents, cut and fill-Urban land complex, 5 to 75 percent slopes		10.8	23.6%
132	Urban land-Orthents, cut and fill complex, 0 to 5 percent slopes	0.0000	0.3	0.6%
Totals for Area of Interest			**45.5**	**100.0%**

Description

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits.

Rating Options

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: *None Specified*

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options: All Layers


122° 21' 25"
122° 20' 49"
37° 31' 14"
37° 30' 55"
37° 30' 54"
556900
557000
557100
557200
557300
557400
557500
557600
557700
4152800
4152700
4152600
4152500
4152400
4152300
Monticello Rd
Yorktown Rd
Lexington Ave
132
113
124
120
Map Scale: 1:4,300 if printed on A size (8.5" x 11") sheet.
N
Meters
0 50 100 200 300
Feet
0 200 400 800 1,200

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- CH
- CL
- CL-A (proposed)
- CL-K (proposed)
- CL-ML
- CL-O (proposed)
- CL-T (proposed)
- GC
- GC-GM
- GM
- GP
- GP-GC
- GP-GM
- GW
- GW-GC
- GW-GM
- MH
- MH-A (proposed)
- MH-K (proposed)
- MH-O (proposed)
- MH-T (proposed)
- ML
- ML-A (proposed)
- ML-K (proposed)
- ML-O (proposed)
- ML-T (proposed)
- OH
- OH-T (proposed)
- OL
- PT
- SC
- SC-SM
- SM
- SP
- SP-SC
- SP-SM
- SW
- SW-SC
- SW-SM
- Not rated or not available

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:4,300 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Mateo County, Eastern Part, and San Francisco County, California
Survey Area Data: Version 6, Mar 13, 2008

Date(s) aerial images were photographed: 6/12/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Unified Soil Classification (Surface)

Unified Soil Classification (Surface)— Summary by Map Unit — San Mateo County, Eastern Part, and San Francisco County, California				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
113	Fagan loam, 15 to 50 percent slopes		22.0	48.2%
120	Obispo clay, 15 to 30 percent slopes	CH	12.5	27.5%
124	Orthents, cut and fill-Urban land complex, 5 to 75 percent slopes		10.8	23.6%
132	Urban land-Orthents, cut and fill complex, 0 to 5 percent slopes		0.3	0.6%
Totals for Area of Interest			**45.5**	**100.0%**

Description

The Unified soil classification system classifies mineral and organic mineral soils for engineering purposes on the basis of particle-size characteristics, liquid limit, and plasticity index. It identifies three major soil divisions: (i) coarse-grained soils having less than 50 percent, by weight, particles smaller than 0.074 mm in diameter; (ii) fine-grained soils having 50 percent or more, by weight, particles smaller than 0.074 mm in diameter; and (iii) highly organic soils that demonstrate certain organic characteristics. These divisions are further subdivided into a total of 15 basic soil groups. The major soil divisions and basic soil groups are determined on the basis of estimated or measured values for grain-size distribution and Atterberg limits. ASTM D 2487 shows the criteria chart used for classifying soil in the Unified system and the 15 basic soil groups of the system and the plasticity chart for the Unified system.

The various groupings of this classification correlate in a general way with the engineering behavior of soils. This correlation provides a useful first step in any field or laboratory investigation for engineering purposes. It can serve to make some general interpretations relating to probable performance of the soil for engineering uses.

For each soil horizon in the database one or more Unified soil classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Layer Options: Surface Layer

APPENDIX D
CALIBRATION & CULVERT DATA

Watershed Calibrated Parameters

	Rainfall Loss Parameters			Hydrograph Convolution Parameters	
Watershed	Initial Deficit (in)	Maximum Deficit (in)	Constant Loss Rate (in/hr)	Time of Concentration (hr)	Strorage Coefficient (hr)
WS-1	0.30	0.50	0.1300	0.19	2.00
WS-2	0.30	0.50	0.1300	0.10	2.00
WS-3	0.30	0.50	0.1300	0.08	2.00

Evapotranspiration Rates

Month	Evapotranspiration Rate (in/month)
January	1.83
February	2.2
March	3.42
April	4.84
May	5.61
June	6.26
July	6.47
August	6.22
September	4.84
October	3.66
November	2.36
December	1.83

Based on CIMIS Gage #96 in Woodside, CA

Culvert Report

Boat Ramp Overflow Culvert Rating Curve

Invert Elev Dn (ft)	=	291.60
Pipe Length (ft)	=	20.00
Slope (%)	=	2.00
Invert Elev Up (ft)	=	292.00
Rise (in)	=	24.0
Shape	=	Cir
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.012
Inlet Edge	=	Projecting
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.5

Embankment

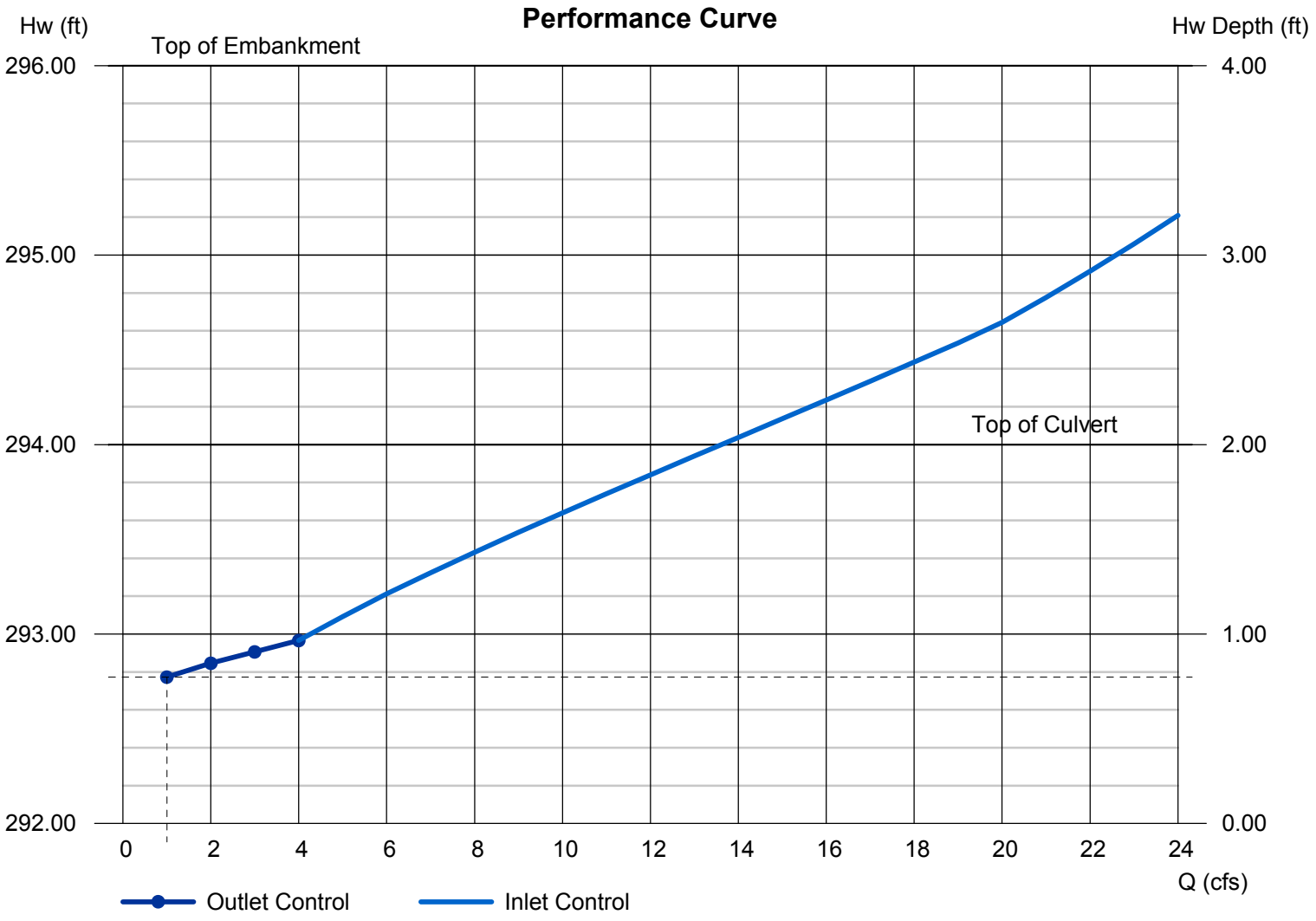
Top Elevation (ft)	=	296.00
Top Width (ft)	=	12.00
Crest Width (ft)	=	12.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	24.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	1.00
Qpipe (cfs)	=	1.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	0.52
Veloc Up (ft/s)	=	0.90
HGL Dn (ft)	=	292.77
HGL Up (ft)	=	292.77
Hw Elev (ft)	=	292.77
Hw/D (ft)	=	0.39
Flow Regime	=	Outlet Control



Appendix E
Reference Sites

Technical Memorandum No. 1
Habitat Reserve Program (HRP) Reference Site Survey Summary

May 20, 2009

INTRODUCTION

The Habitat Reserve Program (HRP) is designed to create, restore or enhance sensitive habitat types that have been impacted by implementation of SFPUC projects. The Project will restore or create the following habitat types: Serpentine Bunchgrass Grassland, Valley Needlegrass Grassland, Semi-permanent Marsh or Pond, Seasonal Wetland, Coast Live Oak Woodland, Mixed Oak Woodland, and Coast Live Oak Riparian Forest.

Initially, NRM Environmental Consulting (NRM) was contracted by Winzler and Kelly to conduct reconnaissance surveys of references sites in support of the Homestead Pond project. Reference sites were identified by Greg Lyman of the SFPUC, and were provided on a Google Earth Map. Reference sites were chosen that best reflected several of the above mentioned habitats. The present TM is built upon findings included in a memo from NRM dated December 15, 2008, and has been greatly expanded.

With the transition to design for additional HRP sites, a wider range of restoration efforts are now envisioned, and it has become necessary to expand the number of reference sites. The reference sites will be used as a general baseline for the restoration in the Project Areas, particularly to identify habitat structure and dominant or characteristic species. Reference sites are not intended to be tied to mitigation success criteria, although in some cases they may be used to inform decisions as success criteria are formulated. Reference sites were surveyed for dominant vegetation within the tree layer, shrub layer, and understory layer (forbs and grasses).

Native plant species observed at the reference sites, along with information included in a previous vegetation survey (URS, 2004) and other relevant sources, will be used as general guidance for the associated habitat's planting palettes within the Project.

METHODS

Reconnaissance surveys were conducted by NRM on December 12, 2008, when vegetation within the understory layer (grasses and forbs) was predominantly unidentifiable. Many native plants that were identifiable to genus were not identified to species due to the seasonal limitations. After review of the NRM data, Winzler & Kelly conducted more detailed surveys on April 7-9 and May 6-7, 2009. Available regional vegetation surveys in addition to the NRM (2008) data were reviewed, including Schirokauer, et al, (2003), URS (2004) and ESA+Orion (2009). Site vegetation surveys were conducted using the California Native Plant Society Relevé Protocol (CNPS, October 20, 2000, revised April 2004).

RESULTS

A brief summary and representative photo of each reference site follows. Community type nomenclature generally follows Holland (1986). A map of the reference sites is shown in Figure 1, and more detailed information for each site is included in Appendix A

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1. Herbaceous Communities

1.1 Serpentine Bunchgrass

Three serpentine bunchgrass grassland sites were visited. These are described individually below.

S-1 Edgewood Triangle Serpentine Bunchgrass

Serpentine bunchgrass community at Edgewood Triangle

The Edgewood Triangle site is located directly across Cañada Road to the east of Homestead Pond. The site is a west facing slope with a rocky serpentine soil. The dominant and subdominant plants that were discernible included purple needle grass (*Nassella pulchra*), squirrel tail (*Elymus elymoides*), blue wildrye, meadow barley (*Hordeum brachyantherum*), soap plant (*Chloragalum pomeridianum*), blue-eyed grass (*Sisyrinchium bellum*), California plantain (*Plantago erecta*), purple owl's clover (*Castilleja exserta*), California poppy (*Eschscholtzia californica*), common lomatium (*Lomatium utriculatum*), yarrow (*Achillea millefolium*), Ithuriel's spear (*Triteleia laxa*), blue dicks (*Dichelostemma capitatum*), harvest brodiaea (*Brodiaea elegans*), fringed mallow (*Sidalcea diploscypha*), Coast Range false bindweed (*Calystegia collina*), western larkspur (*Delphinum hesperium*), annual dog's tail (*Cynosurus echinatus*), star thistle (*Centaurea solstitalis*), annual cat's ear (*Hypochaeris glabra*), yellow owl's clover (*Orthocarpus luteus*) and hayfield tarweed (*Hemizonia congesta*). This site is an excellent reference site because it is adjacent to Homestead Pond.

S-2 Lower Crystal Springs Boat Ramp Serpentine Bunchgrass

Serpentine bunchgrass community at Lower Crystal Springs boat ramp. Note fountain thistle at left of image.

The Boat Ramp site is located north of Highway 92 and west of Highway 35 near the boat ramp into the Lower Crystal Springs Reservoir. The site is located on a relatively flat area with a gentle west-facing aspect, and few small rock outcrops. Groundwater seepage is evident along the cut bank at the edge of the reservoir. The dominant and subdominant plants that were discernible included purple needle grass, (*Nassella pulchra*), coyote brush (*Baccharis pilularis*), blue wildrye, fountain thistle (*Cirsium fontinale* var. *fontinale*), perennial hair grass (*Deschampsia cespitosa*), soap plant, blue-eyed grass, California plantain, California oat grass, Fremont's death camas (*Zigadenus fremontii*), common lomatium, yarrow, Ithuriel's spear, blue dicks, harvest brodiaea, soft chess, annual cat's ear , yellow owl's clover and hayfield tarweed. Presence of perennial hair grass, Fremont's death camas and fountain thistle suggest elevated groundwater influence at this site.

S-3 Trousdale Serpentine Bunchgrass

Serpentine bunchgrass community adjacent to Trousdale sag pond

A third site, identified here as the Trousdale site after the nearest I-280 exit, is located well to the north, between San Andreas Reservoir and Tracy Lake. This site is in the rift valley at an elevation of approximately 350 feet, and is nearly level to slightly east-facing with scattered small rock outcrops. Dominant and subdominant native species include purple needle grass, (*Nassella pulchra*), Sandberg's bluegrass (*Poa secunda*), blue wildrye, California oatgrass, ookow (*Dichelostemma congesta*), blue-eyed grass, California plantain, meadow barley, coyote mint (*Monardella villosa*), June grass (*Koeleria macrantha*), yarrow, California goldfields (*Baeria californica*), California melic (*Melica californica*), harvest brodiaea, California brome (*Bromus carinatus*), Coast Range false bindweed, naked-stem buckwheat (*Eriogonum nudum*), annual dog's tail, annual cat's ear, yellow owl's clover and hayfield tarweed. Absent are hydrophylls, such as perennial hairgrass due to the lack of elevated groundwater despite the proximity of the adjacent sag pond. The evident species diversity is high possibly due the distance from the nearest roads and frequent disturbance.

1.2 Valley Needlegrass Grassland

One grassland site was visited. For purposes of site design and planting plan preparation, this site was supplemented with data from three other grassland sites in URS (2004).

V-1 Adobe Gulch Coastal Terrace Prairie

Coastal terrace prairie at Adobe Gulch, just east of Old Cañada Road.

One reference site was visited for native bunchgrass grassland. The site includes multiple remnant grassland openings with the Adobe Gulch area, south of Rt. 92 and between Old Cañada Road and Upper Crystal Springs reservoir. ESA (2009) characterized the overall site as coastal terrace prairie, and hypothesized that the area acted as a fog sink and thus encouraged species more characteristic of areas closer to the coast. Two openings, one at each end of the Adobe Grasslands site, were sampled. The openings are relatively small with encroaching scrub habitat. Native cover is approximately 50%, and dominant and subdominant species include purple needle grass, California oatgrass, blue wildrye, blue-eyed grass, Douglas iris (*Iris douglasiana*), Indian paintbrush (*Castilleja affinis*), yarrow, foothill sedge (*Carex tumulicola*), spreading rush (*Juncus patens*), sun-cups (*Camissonia ovata*), six-week fescue (*Vulpia bromoides*), soft chess, perennial cat's ear (*Hypochaeris radicata*), ripgut brome (*Bromus diandrus*), English plantain (*Plantago lanceolata*), bur-clover (*Medicago arabica*), rattlesnake grass (*Bromus brizaeformis*) and annual hairgrass (*Aria caryophyllea*).

2. Wetland Communities

2.1 Coastal and Valley Freshwater Marsh

Three wetlands sites, each representing a different hydrologic regime, were sampled. These are described individually below.

W-1. Trousdale Semi-permanent pond

Semi-permanent wetland at Trousdale sag pond

One semi-permanent pond was visited. This site is located south of San Andreas Reservoir, and west-southwest of the terminus of Trousdale Road at Interstate 280. The pond provides habitat for both California red-legged frog and San Francisco garter snake (K. Swaim, pers. comm., and verified in the field by Winzler & Kelly in April and May of 2009). The pond serves primarily as a hydrological benchmark, and secondarily as a vegetation reference site. The eastern margin of the pond is steep, while the other three margins have a much more gradual slope. Maximum depth is uncertain but is considerably greater than three feet. Dominant and subdominant vegetation includes Baltic rush (*Juncus balticus*), iris-leafed rush (*Juncus xiphioides*), soft rush (*Juncus effusus*), water parsley (*Oenanthe sarmentosa*), common spikerush (*Eleocharis macrostachya*), willow-leaved dock (*Rumex salicifolius*) and penny-royal (*Mentha pulegium*). Species in the upper margin of the wetland include Creeping ryegrass (*Leymus triticoides*), creeping bentgrass (*Agrostis stolonifera*), spreading rush (*Juncus patens*), foothill sedge (*Carex tumulicola*), arroyo willow (*Salix laevigata*) and red willow (*Salix lasiolepis*)

W-2. Old Cañada Road Seasonal Wetland

Seasonal wetland along Old Cañada Road.

One seasonal wetland reference site was visited, a sag pond, located adjacent to Old Cañada Road. The pond was dry in December 2008 and held shallow water (at least six inches deep) in April and May 2009. During a May 6, 2009 site visit, numerous pacific tree frog (*Pseudacris regilla*) tadpoles and some recent metamorphs were observed, documenting successful amphibian recruitment at this wetland. The entire wetland is densely vegetated and is dominated by spikerush (*Eleocharis macrostachys*) and California semaphore grass (*Pleuropogon californica*). The southern boundary is dominated by creeping rush (*Juncus patens*) and the northern boundary is dominated by creeping wildrye (*Leymus triticoides*). The surrounding upland area includes coast live oak to the west and coyote brush to the east.

W-3. Lower Crystal Springs Fringe Wetland

Above: Fringe marsh along Lower Crystal Springs reservoir, near the boat ramp.

A fringe wetland along Lower Crystal Springs Reservoir, located adjacent to the boat ramp, was sampled. This wetland differs in being subjected to potentially more rapid and more extreme fluctuations in water level as the reservoir is drawn down, and in use by large fish. In May 2009 several large carp were observed within this wetland, with an obvious short-term increase in turbidity related to bottom foraging. Dominant and subdominant plants include Common bulrush (*Scirpus acutus*), narrow-leaved cat-tail (*Typha angustifolia*), marsh baccharis (*Baccharis douglasii*), spreading rush (*Juncus patens*), tall flat-sedge (*Cyperus eragrostis*), common rush (*Juncus effusus*), California dock (*Rumex salicifolius*), horseweed (*Conyza canadensis*), creeping bent-grass (*Agrostis stolonifera*) and poison hemlock (*Conium maculatum*).

3. Woodland and Forest Communities

Two oak woodland communities were visited, one dominated by coast live oak, and one mixed oak woodland with coast live oak and valley oak. In addition, two riparian forest sites were characterized. These sites are described below.

3.1 Coast Live Oak Woodland

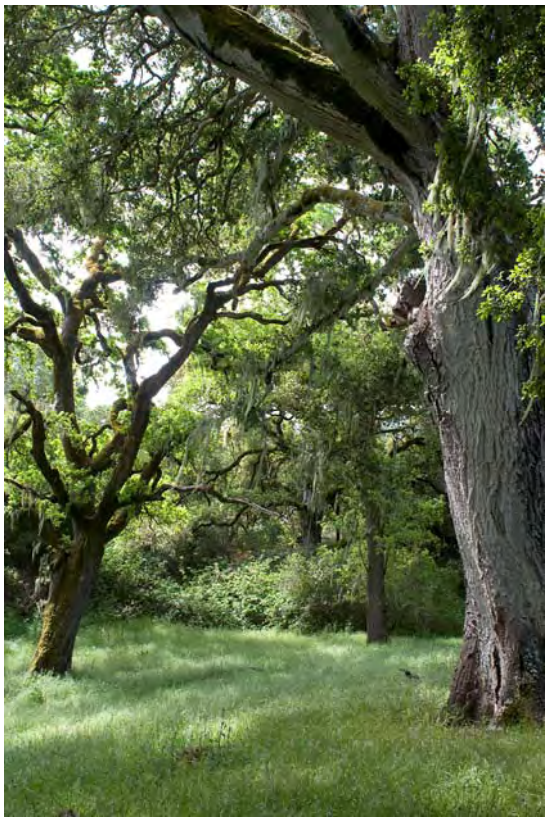
O-1. Adobe Gulch Coast Live Oak Woodland

Above: Coast live oak woodland at Adobe Gulch

One reference site was visited, located on the west side of Crystal Springs Reservoir, near Adobe Point. It can only be accessed along Old Cañada Road. The site is a long, narrow north-south tending ridge that is forested with a mix of coast live oaks and Pacific madrone. Dominant and subdominant species include coast live oak (*Quercus agrifolia*) and Pacific madrone (*Arbutus menziesii*), Poison oak (*Toxicodendron diversilobum*), toyon (*Heteromeles arbutifolia*), California coffeeberry (*Rhamnus californica*), hillside gooseberry (*Ribes californicum*), and common snowberry (*Symphoricarpos albus*). The understory includes California blackberry (*Rubus californica*), Douglas iris (*Iris douglasiana*), blue wildrye (*Elymus glaucus*), Yerba santa (*Satureja douglasii*), hairy honeysuckle (*Lonicera hispidula*), hound's tongue (*Cynoglossum grande*), Pacific sanicle (*Sanicula crassicaulis*), Pacific starflower (*Trientalis latifolia*) and Indian warrior (*Pedicularis densiflora*).

3.2 Mixed Oak Woodland

O-2. Old Cañada Road Mixed Oak Wodland



Above: Mixed oak woodland near Old Cañada Road

This community is intermediate between the valley oak and coast live oak woodlands described by Holland (1986). One reference site was visited, located west of the Pulgas Water Temple and Laguna Creek. It can only be accessed along Old Cañada Road. This reference site is similar to the mixed oak woodland that is currently found at Homestead Pond. The northern boundary is densely vegetated with a mix of California coffeeberry and coast live oaks. The habitat opens up to the south into an oak savanna with an approximate 60/40 allocation of coast live oaks and valley oaks with a mixed grassland understory. Dominant and subdominant native species include coast live oak (*Quercus agrifolia*) and valley oak (*Quercus lobata*), California coffeeberry (*Rhamnus californica*), poison oak (*Toxicodendron diversilobum*), California buckeye (*Aesculus californica*), blue elderberry (*Sambucus mexicana*), and coyote brush (*Baccharis pilularis*). The understory includes yarrow (*Achillea millefolium*), sanicle (*Sanicula crassicaulis*), man-root (*Marah fabaceus*), blue wildrye (*Elymus glaucus*), bedstraw (*Galium aparine*), hound's tongue (*Cynoglossum grande*), and miner's lettuce (*Claytonia perfoliata*). Non-native and invasive species present include dogtail grass (*Cynosurus echinatus*), oat grass (*Avena barbata*), Italian thistle (*Carduus pycnocephalus*), ripgut brome (*Bromus diandrus*), yellow star-thistle (*Centaurea solstitialis*) and milk thistle (*Silybum marianum*).

3.3 Central Coast Live Oak Riparian Forest

Two riparian reference sites were visited. These are similar in composition, and are lumped for description.

Above: Central Coast live oak riparian forest northwest of Homestead Pond Note willows in background, along stream channel, with oaks more prevalent away from the active channel.

Site R-1 is located north of the Project Area west of the Filoli Gardens entrance off of Cañada Road. Site R-2 is located just northwest of Homestead Pond. Both sites are densely vegetated and have intermittent streams measuring approximately 10 to 20 feet across (bank to bank) running through the habitat. Dominant and subdominant native species include coast live oak (*Quercus agrifolia*) and arroyo or red willow (*Salix laevigata*, *S. lasiolepis*), Pacific madrone (*Arbutus menziesii*), California bay (*Umbellularia californica*), Poison oak (*Toxicodendron diversilobum*), California coffeeberry (*Rhamnus californica*), toyon (*Heteromeles arbutifolia*), and coyote brush (*Baccharis pilularis*). The understory includes California blackberry (*Rubus californica*), Douglas iris (*Iris douglasiana*), blue wildrye (*Elymus glaucus*), Yerba santa (*Satureja douglasii*), hairy honeysuckle (*Lonicera hispidula*), mugwort (*Artemisia douglasiana*), and spreading rush (*Juncus patens*). The sites are similar to HRP project sites in location, species makeup, hydrology, and elevation.

LITERATURE CITED

CNPS. 2004. California Native Plant Society Relevé Protocol. CNPS Vegetation Committee.

ESA + Orion. 2009. Peninsula region study area biological resources. Habitat Reserve Program. Unpublished draft report to the San Francisco Public Utilities Commission.

Holland, R. F. 1986. Preliminary descriptions of the terrestrial natural communities California. California Department of Fish and Game.

NRM. 2008. SFPUC - Homestead Pond mitigation reference site survey summary. Unpublished memorandum to Winzler & Kelly, December 15, 2008.

Schirokauer, et al, 2003 Plant Community Classification and Mapping Project, Final Report

URS Corporation. 2004. Vegetation Survey of the Peninsula and Alameda Watersheds (Task 6) Agreement No. CS-699E

Appendix F: Plant Species Composition of Serpentine Bunchgrass Sites

Genus	Species	Variety	Family	Common Name	Native	Site S-1	Site S-2	Site S-3
Achillea	*millefolium*		*Asteraceae*	yarrow	Native	5		1
Agoseris	*heterophylla*		*Asteraceae*	annual agoseris	Introduced	1		
Agrostis	*microphylla*		*Poaceae*	small leaf bunchgrass	Native	1		
Aira	*caryophyllea*		*Poaceae*	silver hairgrass	Introduced	2	2	1
Anagallis	*arvensis*		*Primulaceae*	scarlet pimpernel	Introduced		1	
Aphanes	*occidentalis*		*Rosaceae*	field parsley	Native	1		
Arabis	*blepharophylla*		*Brassicaceae*	rose rockcress	Native	1		
Avena	*fatua*		*Poaceae*	wild oat	Introduced		1	1
Baccharis	*pilularis*		*Asteraceae*	coyote brush	Native		5	1
Brodiaea	*terrestris*		*Liliaceae*	dwarf clusterlily	Native		1	
Bromus	*carinatus*		*Poaceae*	California brome	Native	3	2	3
Bromus	*diandrus*		*Poaceae*	ripgut brome	Introduced			
Bromus	*hordeaceus*		*Poaceae*	soft chess	Introduced	3	2	1
Calandrinia	*ciliata*		*Portulacaceae*	red maids	Native		1	
Calystegia	*subacaulis*		*Convolvulaceae*	hillside false bindweed	Native	5		1
Castilleja	*densiflora*		*Scrophulariaceae*	denseflower owl's-clover	Native	1	1	
Castilleja	*rubicundula*	*lithospermoides*	*Scrophulariaceae*	cream sacs	Native	2		
Centaurea	*solstitialis*		*Asteraceae*	yellow star thistle	Introduced	3		
Centaurium	*muehlenbergii*		*Gentianaceae*	Muhlenberg's centaury	Native		1	
Chlorogalum	*pomeridianum*		*Liliaceae*	soaproot	Native		5	1
Cirsium	*fontinale*	*fontinale*	*Asteraceae*	fountain thistle	Native		2	
Clarkia	*purpurea*	*quadrivulnera*	*Onagraceae*	winecup fairyfan	Native	2		1
Clarkia	*rubicunda*	*rubicunda*	*Onagraceae*	ruby chalice clarkia	Native			
Crassula	*connata*		*Crassulaceae*	pygmy-weed	Native		1	1
Cuscuta	*californica*		*Cuscutaceae*	chaparral dodder	Native	2		
Danthonia	*californica*		*Poaceae*	California oatgrass	Native	5	7	3
Daucus	*pusillus*		*Apiaceae*	American wild carrot	Native	1	1	
Delphinium	*hesperium*	*hesperium*	*Ranunculaceae*	foothill larkspur	Native	1	2	
Deschampsia	*cespitosa*	*cespitosa*	*Poaceae*	tufted hairgrass	Native		5	
Deschampsia	*danthonioides*		*Poaceae*	annual hairgrass	Native	1		1
Dichelostemma	*capitatum*		*Liliaceae*	blue dicks	Native	1	1	
Dichelostemma	*congestum*		*Liliaceae*	ookow	Native			2
Elymus	*glaucus*		*Poaceae*	blue wildrye	Native	1	1	5
Elymus	*multisetus*		*Poaceae*	big squirreltail	Native	3		

Appendix F: Plant Species Composition of Serpentine Bunchgrass Sites

Genus	Species	Variety	Family	Common Name	Native	Site S-1	Site S-2	Site S-3
Epilobium	*brachycarpum*		*Onagraceae*	autumn willowweed	Native	1	1	1
Eriogonum	*nudum*		*Polygonaceae*	naked buckwheat	Native	2	1	5
Eschscholzia	*californica*		*Papaveraceae*	California poppy	Native	3	1	1
Euphorbia	*pelus*		*Euphobiaceae*	petty spurge	Introduced			1
Festuca	*rubra*		*Poaceae*	red fescue	Introduced	5	2	
Gastridium	*ventricosum*		*Poaceae*	nit grass	Introduced	1		
Grindelia	*camporum*		*Asteraceae*	Great Valley gumweed	Native	1	1	
Hemizonia	*congesta*	*luzulifolia*	*Asteraceae*	hayfield tarweed	Native	5		
Hordeum	*brachyantherum*		*Poaceae*	meadow barley	Native	5		
Hypochaeris	*glabra*		*Asteraceae*	smooth cat's ear	Introduced	3	1	1
Koeleria	*macrantha*		*Poaceae*	junegrass	Native	1	1	3
Lactuca	*saligna*		*Asteraceae*	slender leaf lettuce	Introduced	1	1	
Lasthenia	*californica*		*Asteraceae*	common goldfields	Native	5	2	5
Layia	*platyglossa*		*Asteraceae*	tidy-tips	Native	1		
Lolium	*multiflorum*		*Poaceae*	Italian ryegrass	Introduced	2		5
Lomatium	*utriculatum*		*Apiaceae*	common lomatium	Native	2	5	1
Lotus	*humistratus*		*Fabaceae*	foothill deervetch	Native		1	
Lotus	*wrangelianus*		*Fabaceae*	Chilean trefoil	Native	1	1	
Lupinus	*bicolor*		*Fabaceae*	bicolor lupine	Native	1		
Melica	*californica*		*Poaceae*	California melic	Native	1		5
Mimulus	*guttatus*		*Scrophulariaceae*	seep monkeyflower	Native		1	
Monardella	*villosa*		*Lamiaceae*	coyote mint	Native			2
Nassella	*lepida*		*Poaceae*	foothill needlegrass	Native	1		
Nassella	*pulchra*		*Poaceae*	purple needlegrass	Native	10	5	5
Phacelia	*californica*		*Hydrophyllaceae*	California scorpionweed	Native	2		
Plantago	*erecta*		*Plantaginaceae*	rock plantago	Native	5	2	
Poa	*secunda*		*Poaceae*	one-sided bluegrass	Native	1	1	5
Pteridium	*aquilinum*	*pubescens*	*Dennstaedtiaceae*	bracken fern	Native	1		
Ranunculus	*californicus*	*californicus*	*Ranunculaceae*	California buttercup	Native			1
Rumex	*acetosella*		*Polygonaceae*	common sheep sorrel	Introduced	2	1	
Sanicula	*bipinnatifida*		*Apiaceae*	purple sanicle	Native		1	
Scrophularia	*californica*		*Scrophulariaceae*	California figwort	Native			1
Sidalcea	*diploscypha*		*Malvaceae*	fringed checkermallow	Native	3	1	1
Silene	*gallica*		*Caryophyllaceae*	common catchfly	Introduced	1	1	
Sisyrinchium	*bellum*		*Iridaceae*	western blue-eyed grass	Native	3	1	1

Appendix F: Plant Species Composition of Serpentine Bunchgrass Sites

Genus	Species	Variety	Family	Common Name	Native	Site S-1	Site S-2	Site S-3
Sonchus	*asper*		*Asteraceae*	spiny sowthistle	Introduced			1
Toxicodendron	*diversilobum*		*Anacardiaceae*	pacific poison oak	Native	1		1
Trifolium	*albopurpureum*	*dichotomum*	*Fabaceae*	branched Indian clover	Native		1	
Trifolium	*ciliolatum*		*Fabaceae*	foothill clover	Native		1	
Trifolium	*microdon*		*Fabaceae*	thimble clover	Native	1	1	1
Trifolium	*variegatum*		*Fabaceae*	variegated clover	Native	1		
Trifolium	*willdenovii*		*Fabaceae*	tomcat clover	Native	1		
Triteleia	*hyacinthina*		*Liliaceae*	white brodiaea	Native	2		
Triteleia	*laxa*		*Liliaceae*	Ithuriel's spear	Native	3		1
Vulpia	*bromoides*		*Poaceae*	brome fescue	Introduced	2	2	5
Vulpia	*microstachys*	*pauciflora*	*Poaceae*	pacific fescue	Native	2	2	1
Vulpia	*myuros*	*hirsuta*	*Poaceae*	rattail fescue	Introduced		2	
Zigadenus	*fremontii*		*Liliaceae*	Fremont's death camas	Native		2	

The % cover is given for plant species found in each site.

Appendix F: Plant Species Composition of Valley Needlegrass Grassland Sites

Genus	Species	Variety	Family	Common Name	Native	Site V-1
Acaena	*pinnafida*	*californica*	*Rosaceae*	sheepburr	Native	1
Achillea	*millefolium*		*Asteraceae*	yarrow	Native	5
Agoseris	*grandiflora*		*Asteraceae*	bigflower agoseris	Native	1
Aira	*caryophyllea*		*Poaceae*	silver hairgrass	Introduced	2
Anagallis	*arvensis*		*Primulaceae*	scarlet pimpernel	Introduced	1
Aster	*chilensis*		*Asteraceae*	creeping aster	Native	1
Aster	*radulinus*		*Asteraceae*	roughleaf aster	Native	1
Avena	*barbata*		*Poaceae*	slender oat	Introduced	1
Avena	*fatua*		*Poaceae*	wild oat	Introduced	5
Baccharis	*pilularis*		*Asteraceae*	coyote brush	Native	1
Berberis	*sp.*		*Berberidaceae*	barberry	Native	1
Brachypodium	*distachyon*		*Poaceae*	purple false brome	Introduced	1
Briza	*minor*		*Poaceae*	small quaking grass	Introduced	1
Brodiaea	*terrestris*		*Liliaceae*	dwarf clusterlily	Native	1
Bromus	*brizaeformis*		*Poaceae*	rattlesnake grass	Introduced	4
Bromus	*carinatus*		*Poaceae*	California brome	Native	2
Bromus	*diandrus*		*Poaceae*	ripgut brome	Introduced	5
Bromus	*hordeaceus*		*Poaceae*	soft chess	Introduced	7
Calystegia	*subacaulis*		*Convolvulaceae*	hillside false bindweed	Native	1
Camissonia	*ovata*		*Onagraceae*	sun-cups	Native	2
Carduus	*pycnocephalus*		*Asteraceae*	Italian plumeless thistle	Introduced	2
Carex	*tumulicola*		*Cyperaceae*	foothill sedge	Native	3
Castilleja	*affinis*		*Scrophulariaceae*	Indian paintbrush	Native	3
Centaurea	*melitensis*		*Asteraceae*	tocalote	Introduced	1
Cerastium	*glomeratum*		*Caryophyllaceae*	sticky chickweed	Introduced	1
Chlorogalum	*pomeridianum*		*Liliaceae*	soaproot	Native	1
Cynosurus	*echinatus*		*Poaceae*	annual dogtail	Introduced	1
Danthonia	*californica*		*Poaceae*	California oatgrass	Native	10
Daucus	*pusillus*		*Apiaceae*	American wild carrot	Native	1
Dichelostemma	*congestum*		*Liliaceae*	fork-toothed ookow	Native	1
Elymus	*elymoides*		*Poaceae*	squirreltail	Native	5
Elymus	*glaucus*		*Poaceae*	blue wildrye	Native	7
Epilobium	*brachycarpum*		*Onagraceae*	autumn willowherb	Native	1
Epilobium	*sp.*		*Onagraceae*	fireweed	Native	1

Appendix F: Plant Species Composition of Valley Needlegrass Grassland Sites

Genus	Species	Variety	Family	Common Name	Native	Site V-1
Eriogonum	*nudum*		*Polygonaceae*	naked buckwheat	Native	1
Erodium	*brachycarpum*		*Geraniaceae*	shortfruit stork's bill	Introduced	1
Erodium	*cicutarium*		*Geraniaceae*	cranesbill	Introduced	1
Erodium	*moschatum*		*Geraniaceae*	musky stork's bill	Introduced	1
Eschscholzia	*californica*		*Papaveraceae*	California poppy	Native	1
Euphorbia	*pelus*		*Euphobiaceae*	petty spurge	Introduced	1
Festuca	*rubra*		*Poaceae*	red fescue	Introduced	1
Filago	*gallica*		*Asteraceae*	narrow-leaved filago	Introduced	1
Galium	*parisiense*		*Rubiaceae*	wall bedstraw	Introduced	1
Gastridium	*ventricosum*		*Poaceae*	nit grass	Introduced	1
Geranium	*dissectum*		*Geraniaceae*	cutleaf geranium	Introduced	1
Grindelia	*sp.*		*Asteraceae*	gumweed	Native	1
Hordeum	*brachyantherum*		*Poaceae*	meadow barley	Native	1
Hordeum	*jubatum*		*Poaceae*	foxtail barley	Introduced	1
Hypochaeris	*glabra*		*Asteraceae*	smooth cat's ear	Introduced	1
Hypochaeris	*radicata*		*Asteraceae*	rough cat's ear	Introduced	5
Iris	*douglasiana*		*Iridaceae*	Douglas iris	Native	2
Juncus	*patens*		*Juncaceae*	spreading rush	Native	3
Koeleria	*macrantha*		*Poaceae*	junegrass	Native	1
Linum	*bienne*		*Linaceae*	flax	Introduced	1
Lolium	*multiflorum*		*Poaceae*	Italian ryegrass	Introduced	2
Lomatium	*dasycarpum*		*Apiaceae*	woollyfruit desert parsley	Native	1
Lonicera	*hispidula*	*vacillans*	*Caprifoliaceae*	pink honeysuckle	Native	1
Lotus	*humistratus*		*Fabaceae*	foothill deervetch	Native	1
Lotus	*wrangelianus*		*Fabaceae*	Chilean trefoil	Native	1
Lupinus	*formosus*		*Fabaceae*	western lupine	Native	1
Lupinus	*sp.*		*Fabaceae*	lupine	Native	1
Luzula	*comosa*		*Juncaceae*	hairy woodrush	Native	1
Luzula	*sp.*		*Juncaceae*	woodrush	Native	1
Madia	*gracilis*		*Asteraceae*	slender tarweed	Native	2
Madia	*sativa*		*Asteraceae*	coast tarweed	Native	1
Marah	*sp.*		*Cucurbitaceae*	manroot	Native	1
Medicago	*arabica*		*Fabaceae*	bur-clover	Introduced	5
Micropus	*sp.*		*Asteraceae*	cotton seed	Native	1
Monardella	*villosa*		*Lamiaceae*	coyote mint	Native	1

Appendix F: Plant Species Composition of Valley Needlegrass Grassland Sites

Genus	Species	Variety	Family	Common Name	Native	Site V-1
Nassella	*lepida*		*Poaceae*	foothill needlegrass	Native	1
Nassella	*pulchra*		*Poaceae*	purple needlegrass	Native	15
Perideridia	*kelloggii*		*Apiaceae*	Kellogg's yampah	Native	1
Plantago	*erecta*		*Plantaginaceae*	rock plantago	Native	2
Plantago	*lanceolata*		*Plantaginaceae*	English plantain	Introduced	4
Ranunculus	*sp.*		*Ranunculaceae*	buttercup	Native	1
Rhamnus	*californica*		*Rhamnaceae*	coffeeberry	Native	1
Ribes	*aureum*		*Grossulariaceae*	golden currant	Native	1
Ribes	*sp.*		*Grossulariaceae*	gooseberry	Native	1
Rubus	*ursinus*		*Rosaceae*	California blackberry	Native	1
Rumex	*acetosella*		*Polygonaceae*	sheep sorrel	Introduced	1
Sanicula	*arctopoides*		*Apiaceae*	footsteps of spring	Native	1
Sanicula	*bipinnatifida*		*Apiaceae*	purple sanicle	Native	1
Satureja	*douglasii*		*Lamiaceae*	yerba buena	Native	1
Sherardia	*arvensis*		*Rubiaceae*	field madder	Introduced	1
Sidalcea	*malvaeflora*		*Malvaceae*	checker mallow	Native	1
Silene	*gallica*		*Caryophyllaceae*	common catchfly	Introduced	1
Sisyrinchium	*bellum*		*Iridaceae*	blue-eyed grass	Native	5
Sonchus	*asper*		*Asteraceae*	spiny sowthistle	Introduced	1
Stachys	*ajugoides*	*rigida*	*Lamiaceae*	rigid hedge-nettle	Native	1
Torilis	*arvensis*		*Apiaceae*	spreading hedge parsley	Introduced	1
Torilis	*nodosa*		*Apiaceae*	knotted hedge parsley	Introduced	1
Toxicodendron	*diversilobum*		*Anacardiaceae*	poison oak	Native	2
Trifolium	*dubium*		*Fabaceae*	shamrock	Introduced	3
Trifolium	*macraei*		*Fabaceae*	Chilean clover	Native	1
Trifolium	*microdon*		*Fabaceae*	thimble clover	Native	1
Trifolium	*sp.*		*Fabaceae*	clover	Introduced	1
Trillium	*sp.*		*Liliaceae*	trillium	Native	1
Triteleia	*laxa*		*Liliaceae*	Ithuriel's spear	Native	1
Triteleia	*sp.*		*Lilliaceae*	triteleia	Native	1
Vicia	*sativa*	*sativa*	*Fabaceae*	common vetch	Introduced	1
Vicia	*sp.*		*Fabaceae*	vetch	Introduced	1
Vulpia	*bromoides*		*Poaceae*	brome fescue	Introduced	2
Vulpia	*microstachys*	*pauciflora*	*Poaceae*	pacific fescue	Native	1
Vulpia	*myuros*	*hirsuta*	*Poaceae*	rattail fescue	Introduced	1

Appendix F: Plant Species Composition of Valley Needlegrass Grassland Sites

Genus	Species	Variety	Family	Common Name	Native	Site V-1
Wyethia	*angustifolia*		*Asteraceae*	California compassplant	Native	1
Yabea	*microcarpa*		*Apiaceae*	falsecarrot	Native	1
Zigadenus	*fremontii*		*Liliaceae*	Fremont's death camas	Native	1

The % cover class is provided for each plant species.

Appendix F: Plant Species Composition of Freshwater Marsh Sites

Genus	Species	Variety	Family	Common Name	Native	Site W-1	Site W-2	Site W-3
Achillea	*millefolium*		*Asteraceae*	yarrow	Native	2	4	5
Agrostis	*stolonifera*		*Poaceae*	creeping bent grass	Introduced	10		3
Baccharis	*douglasii*		*Asteraceae*	saltmarsh baccharis	Native		5	10
Carex	*bolanderi*		*Cyperaceaea*	Bolander's sedge	Native	1		
Carex	*tumulicola*		*Cyperaceaea*	splitawn sedge	Native	5		
Cirsium	*vulgare*		*Asteraceae*	bull thistle	Introduced	1	1	
Conium	*maculatum*		*Apiaceae*	poison hemlock	Introduced			5
Conyza	*canadensis*		*Asteraceae*	horseweed	Native			3
Cyperus	*eragrostis*		*Cyperaceae*	tall flatsedge	Native	2	2	10
Deschampsia	*cespitosa*	*cespitosa*	*Poaceae*	tufted hairgrass	Native	5	1	
Deschampsia	*danthonioides*		*Poaceae*	annual hairgrass	Native			2
Eleocharis	*macrostachya*		*Cyperaceae*	spikerush	Native	10		1
Epilobium	*ciliatum*		*Onagraceae*	hairy willowherb	Native			1
Geranium	*dissectum*		*Geraniaceae*	cutleaf geranium	Introduced	1		
Holcus	*lanatus*		*Poaceae*	common velvetgrass	Introduced	5		5
Hordeum	*brachyantherum*		*Poaceae*	meadow barley	Native	1	1	
Hordeum	*murinum*		*Poaceae*	Mediterranean barley	Introduced			1
Hypericum	*anagalloides*		*Hypericaceae*	tinker's penny	Native	1		
Hypochaeris	*radicata*		*Asteraceae*	rough cat's ear	Introduced	1		
Juncus	*balticus*		*Juncaceae*	Baltic rush	Native	5		
Juncus	*effusus*		*Juncaceae*	soft rush	Native		1	
Juncus	*xiphoides*		*Juncaceae*	iris-leafed rush	Native	5		
Juncus	*patens*		*Juncaceae*	spreading rush	Native	1	2	
Leymus	*triticoides*		*Poaceae*	creeping ryegrass	Native	5		
Lolium	*perenne*		*Poaceae*	perennial ryegrass	Introduced			1
Lotus	*corniculatus*		*Fabaceae*	birdfoot deervetch	Introduced	2		1
Lythrum	*hyssopifolium*		*Lythraceae*	loosestrife	Introduced	1		1
Mentha	*pulegium*		*Lamiaceae*	pennyroyal	Introduced			1
Mentha	*arvensis*		*Lamiaceae*	wild mint	Native	1		
Mimulus	*guttatus*		*Scrophulariaceae*	seep monkeyflower	Native	1		
Oenanthe	*sarmentosa*		*Apiaceae*	water parsley	Native	10		
Picris	*echioides*		*Asteraceae*	bristly ox-tongue	Introduced	5		
Pleuropogon	*californica*		*Poaceae*	California semaphore grass	Native		10	
Polygonum	*puncatatum*		*Polygonaceae*	dotted smartweed	Native		1	1
Polypogon	*maritimus*		*Poaceae*	rabbitsfoot grass	Introduced			1
Pyrrocoma	*racemosa*		*Asteraceae*	golden fleece	Native	5	3	10

Appendix F: Plant Species Composition of Freshwater Marsh Sites

Genus	Species	Variety	Family	Common Name	Native	Site W-1	Site W-2	Site W-3
Ribes	*divaricatum*		*Grossulariaceae*	coastal black gooseberry	Native		1	
Rorippa	*curvisiliqua*		*Brassicaceae*	curvepod yellowcress	Native			1
Rubus	*ursinus*		*Rosaceae*	California blackberry	Native		1	
Rumex	*conglomeratus*		*Polygonaceae*	clustered dock	Introduced	1		
Rumex	*crispus*		*Polygonaceae*	curly dock	Introduced			1
Rumex	*salicifolius*		*Polygonaceae*	willow dock	Native	10	5	10
Salix	*laevigata*		*Salicaceae*	arroyo willow	Native	10		
Salix	*lasiolepis*		*Salicaceae*	red willow	Native	10		
Scirpus	*acutus*		*Cyperaceae*	hardstem bulrush	Native			10
Senecio	*hydrophilus*		*Asteraceae*	water ragwort	Native		1	
Sonchus	*asper*		*Asteraceae*	spiny sowthistle	Introduced	1		
Stachys	*ajugoides*		*Lamiaceae*	Ajuga hedge nettle	Native	5		
Trifolium	*wormskioldii*		*Fabaceae*	cow clover	Native	1		
Typha	*angustifolia*		*Typhaceae*	narrow-leaved cattail	Native			5
Typha	*latifolia*		*Typhaceae*	broad-leaved cattail	Native	2	2	3
Veronica	*peregrina*		*Scrophulariaceae*	hairy purslane speedwell	Native			2
Vicia	*sativa*		*Fabaceae*	common vetch	Introduced	1		
Xanthium	*strumarium*		*Asteraceae*	cocklebur	Native			1

The % cover class is provided for each plant species at each site.

Appendix F: Plant Species Composition of Coast Live Oak Woodland Sites

Genus	Species	Variety	Family	Common Name	Native	Site O-1	Site O-2
Adiantum	*jordanii*		*Pteridaceae*	California maiden-hair	Native	1	1
Agrostis	*pallens*		*Poaceae*	seashore bentgrass	Native	1	1
Aira	*caryophyllea*		*Poaceae*	silver hairgrass	Introduced	1	1
Anagallis	*arvensis*		*Primulaceae*	scarlet pimpernel	Introduced	1	1
Arbutus	*menziesii*		*Ericaceae*	madrone	Native	15	15
Artemisia	*douglasiana*		*Asteraceae*	Douglas' sagewort	Native	1	1
Avena	*fatua*		*Poaceae*	wild oat	Introduced	2	10
Baccharis	*pilularis*		*Asteraceae*	coyote brush	Native	5	10
Barbarea	*orthoceras*		*Brassicaceae*	American yellowrocket	Native	1	1
Brachypodium	*distachyon*		*Poaceae*	purple false brome	Introduced	1	1
Bromus	*carinatus*		*Poaceae*	California brome	Native	1	1
Bromus	*diandrus*		*Poaceae*	ripgut brome	Introduced	2	10
Calystegia	*subacaulis*		*Convolvulaceae*	hillside false bindweed	Native	1	1
Carduus	*pycnocephalus*		*Asteraceae*	Italian plumeless thistle	Introduced	1	10
Centaurea	*solstitialis*		*Asteraceae*	yellow star thistle	Introduced		10
Centaurium	*muehlenbergii*		*Gentianaceae*	Muhlenberg's centaury	Native	1	1
Chlorogalum	*pomeridianum*		*Liliaceae*	soaproot	Native	1	1
Cirsium	*vulgare*		*Asteraceae*	bull thistle	Introduced	1	1
Claytonia	*perfoliata*		*Portulacaceae*	miner's lettuce	Native	5	10
Cynoglossum	*grande*		*Boraginaceae*	hound's tongue	Native	10	10
Cynosurus	*echinatus*		*Poaceae*	annual dogtail	Introduced	1	1
Dryopteris	*arguta*		*Dryopteridaceae*	coastal woodfern	Native	1	1
Elymus	*glaucus*		*Poaceae*	blue wildrye	Native	10	10
Epilobium	*densiflorum*		*Onagraceae*	denseflower spike primrose	Native	1	1
Epipactis	*helleborine*		*Orchidaceae*	helleborine	Introduced	1	1
Galium	*aparine*		*Rubiaceae*	bedstraw	Introduced	5	10
Galium	*triflorum*		*Rubiaceae*	fragrant bedstraw	Native	1	1
Gnapthalium	*californicum*		*Asteraceae*	ladies' tobacco	Native	1	1
Heracleum	*lanatum*		*Apiaceae*	common cowparsnip	Native	1	1
Heteromeles	*arbutifolia*		*Rosaceae*	toyon	Native	10	10
Hypochaeris	*radicata*		*Asteraceae*	rough cat's ear	Introduced	1	1
Iris	*douglasiana*		*Iridaceae*	Douglas' iris	Native	5	10
Juncus	*dubius*		*Juncaceae*	dubius rush	Native	1	1
Lolium	*multiflorum*		*Poaceae*	Italian ryegrass	Introduced	5	1

Appendix F: Plant Species Composition of Coast Live Oak Woodland Sites

Genus	Species	Variety	Family	Common Name	Native	Site O-1	Site O-2
Lonicera	*hispidula*		*Caprifoliaceae*	pink honeysuckle	Native	10	10
Lotus	*purshianus*		*Fabaceae*	Spanish clover	Native	1	1
Luzula	*comosa*		*Juncaceae*	hairy woodrush	Native	1	1
Lythrum	*hyssopifolium*		*Lythraceae*	loosestrife	Introduced	1	1
Madia	*exigua*		*Asteraceae*	threadstem tarweed	Native	1	1
Marah	*sp.*		*Cucurbitaceae*	manroot	Native	1	1
Melica	*torreyana*		*Poaceae*	melicgrass	Native	2	2
Monardella	*villosa*		*Lamiaceae*	coyote mint	Native	1	1
Myosotis	*sp.*		*Boraginaceae*	forget-me-not	Introduced	1	1
Navarretia	*mellita*		*Polemoniaceae*	skunk navarretia	Native	1	1
Pedicularis	*densiflora*		*Scrophulariaceae*	Indian warrior	Native	10	15
Pentagramma	*triangularis*		*Pteridaceae*	gold fern	Native	1	1
Phalaris	*aquatica*		*Poaceae*	Harding grass	Introduced	1	1
Physocarpus	*capitatus*		*Rosaceae*	Pacific ninebark	Native	1	1
Picris	*echioides*		*Asteraceae*	bristly ox-tongue	Introduced	1	1
Plantago	*erecta*		*Plantaginaceae*	rock plantago	Native	1	1
Plantago	*lanceolata*		*Plantaginaceae*	narrowleaf plantain	Introduced	1	1
Polystichum	*munitum*		*Dryopteridaceae*	wester swordfern	Native	1	1
Prunus	*sp.*		*Rosaceae*	wild cherry	Native	1	1
Quercus	*agrifolia*		*Fagaceae*	coast live oak	Native	30	30
Quercus	*lobata*		*Fagaceae*	valley oak	Native		15
Rhamnus	*californica*		*Rhamnaceae*	coffeeberry	Native	1	1
Ribes	*californicum*		*Grossulariaceae*	hillside gooseberry	Native	5	2
Rosa	*californica*		*Rosaceae*	California wildrose	Native	1	1
Rosa	*gymnocarpa*		*Rosaceae*	dwarf rose	Native	1	1
Rubus	*ursinus*		*Rosaceae*	California blackberry	Native	20	25
Sambucus	*mexicana*		*Caprifoliaceae*	blue elder	Native	5	10
Sanicula	*crassicaulis*		*Apiaceae*	pacific blacksnakeroot	Native	1	1
Satureja	*douglasii*		*Lamiaceae*	yerba buena	Native	5	10
Silybum	*marianum*		*Asteraceae*	milk thistle	Introduced		10
Sonchus	*asper*		*Asteraceae*	spiny sowthistle	Introduced	1	1
Stellaria	*media*		*Caryophyllaceae*	common chickweed	Introduced	1	1
Symphoricarpos	*albus*		*Caprifoliaceae*	common snowberry	Native	5	5
Thalictrum	*sp.*		*Ranunculaceae*	meadow rue	Native	1	1
Torilis	*arvensis*		*Apiaceae*	spreading hedge parsley	Introduced	1	1

Appendix F: Plant Species Composition of Coast Live Oak Woodland Sites

Genus	Species	Variety	Family	Common Name	Native	Site O-1	Site O-2
Toxicodendron	*diversilobum*		*Anacardiaceae*	pacific poison oak	Native	15	20
Trientalis	*latifolium*		*Primulaceae*	Pacific starflower	Native	5	5
Umbellularia	*californica*		*Lauraceae*	California laurel	Native	2	2
Veronica	*americana*		*Scrophulariaceae*	American speedwell	Native	1	1
Vicia	*americana*	*americana*	*Fabaceae*	American vetch	Native	1	1
Vicia	*sativa*	*sativa*	*Fabaceae*	common vetch	Introduced	1	1

The % cover is provided for plant species found in each site.

Appendix F: Plant Species Composition of Central Coast Live Oak Riparian Forest Sites

Genus	Species	Variety	Family	Common Name	Native	Site R-1
Adiantum	*jordanii*		*Pteridaceae*	California maiden-hair	Native	2
Aquilegia	*formosa*		*Ranunculaceae*	western columbine	Native	1
Arbutus	*menziesii*		*Ericaceae*	Pacific madrone	Native	5
Artemisia	*douglasiana*		*Asteraceae*	Douglas' sagewort	Native	10
Athyrium	*filix-femina*		*Dryopteridaceae*	common ladyfern	Native	1
Baccharis	*pilularis*		*Asteraceae*	coyote brush	Native	5
Bromus	*laevipes*		*Poaceae*	Chinook brome	Native	1
Cardamine	*californica*		*Brassicaceae*	milkmaids	Native	1
Carex	*sp.*		*Cyperaceae*	sedge	Native	1
Corylus	*cornuta*		*Betulaceae*	hazelnut	Native	2
Dicentra	*formosa*		*Papaveraceae*	Pacific bleedingheart	Native	
Disporum	*smithii*		*Liliaceae*	large flower fairybells	Native	2
Dryopteris	*arguta*		*Dryopteridaceae*	coastal woodfern	Native	1
Elymus	*glaucus*		*Poaceae*	blue wildrye	Native	10
Epilobium	*sp.*		*Onagraceae*	fireweed	Native	1
Equisetum	*telmateia*		*Equisetaceae*	giant horsetail	Native	2
Galium	*aparine*		*Rubiaceae*	common bedstraw	Native	5
Galium	*triflorum*		*Rubiaceae*	fragrant bedstraw	Native	2
Galium	*sp.*		*Rubiaceae*	bedstraw	Native	1
Heracleum	*lanatum*		*Apiaceae*	cowparsnip	Native	5
Heteromeles	*arbutifolia*		*Rosaceae*	toyon	Native	5
Heuchera	*sp.*		*Saxifragaceae*	alumroot	Native	1
Juncus	*patens*		*Juncaceae*	spreading rush	Native	10
Lonicera	*hispidula*		*Caprifoliaceae*	hairy honeysuckle	Native	1
Madia	*madioides*		*Asteraceae*	woodland madia	Native	1
Marah	*oreganus*		*Cucurbitaceae*	coast man-root	Native	5
Melica	*torreyana*		*Poaceae*	Torrey's melicgrass	Native	1
Mimulus	*guttatus*		*Scrophulariaceae*	seep monkeyflower	Native	1
Oenanthe	*sarmentosa*		*Apiaceae*	water parsely	Native	2
Osmorhiza	*sp.*		*Apiaceae*	sweetroot	Native	1
Oxalis	*oregana*		*Oxalidaeae*	redwood sorrel	Native	2
Pentagramma	*triangularis*		*Pteridaceae*	gold fern	Native	1
Polypodium	*californicum*		*Polypodiaceae*	California polypody	Native	1
Polystichum	*munitum*		*Dryopteridaceae*	wester swordfern	Native	2

Appendix F: Plant Species Composition of Central Coast Live Oak Riparian Forest Sites

Genus	Species	Variety	Family	Common Name	Native	Site R-1
Pseudotsuga	*menziesii*		*Pinaceae*	Douglas fir	Native	1
Quercus	*agrifolia*		*Fagaceae*	coast live oak	Native	25
Rhamnus	*californica*		*Rhamnaceae*	coffeeberry	Native	5
Rubus	*parviflorus*		*Rosaceae*	thimbleberry	Native	2
Rubus	*ursinus*		*Rosaceae*	California blackberry	Native	2
Salix	*laevigata*		*Salicaceae*	arroyo willow	Native	5
Salix	*lasiolepis*		*Salicaceae*	red willow	Native	10
Sambucus	*racemosa*		*Caprifoliaceae*	scarlet elderberry	Native	2
Sanicula	*crassicaulis*		*Apiaceae*	pacific blacksnakeroot	Native	1
Scoliopus	*bigelovii*		*Liliaceae*	California fetid adderstongue	Native	1
Scrophularia	*californica*		*Scrophulariaceae*	California figwort	Native	1
Smilacina	*stellata*		*Liliaceae*	little false solomon's seal	Native	2
Solanum	*sp.*		*Solanaceae*	nightshade	Native	
Stachys	*chamissonis*		*Lamiaceae*	coast hedge nettle	Native	5
Stachys	*sp.*		*Lamiaceae*	hedgenettle	Introduced	1
Stellaria	*media*		*Caryophyllaceae*	common chickweed	Introduced	1
Symphoricarpos	*albus*		*Caprifoliaceae*	common snowberry	Native	10
Tellima	*grandiflora*		*Saxifragaceae*	fringe cups	Native	5
Torilis	*sp.*		*Apiaceae*	hedge parsley	Introduced	1
Toxicodendron	*diversilobum*		*Anacardiaceae*	pacific poison oak	Native	2
Trientalis	*latifolia*		*Caryophyllaceae*	broadleaf starflower	Native	1
Umbellularia	*californica*		*Lauraceae*	California laurel	Native	10
Urtica	*dioica*	*holosericea*	*Urticaceae*	hoary nettle	Native	2
Woodwardia	*fimbriata*		*Blechnaceae*	giant chainfern	Native	1

The % cover is provided for each plant species found in each site.

Appendix F. Peninsula Reference Site Locations

Site	Community Type	Latitude	Longitude
S1	Serpentine bunchgrass	37.462878	-122.294872
S2	Serpentine bunchgrass	37.514516	-122.353826
S3	Serpentine bunchgrass	37.572201	-122.403932
V1a	Coastal terrace prairie	37.499451	-122.344004
V1b	Coastal terrace prairie	37.499251	-122.359286
W1	Freshwater marsh	37.572234	-122.403577
W2	Freshwater marsh (seasonal wetland)	37.462749	-122.307541
W3	Freshwater marsh	37.516605	-122.357151
O1	Coast live oak woodland	37.498983	-122.343167
O2	Mixed oak woodland	37.479251	-122.320067
R1	Coast live oak riparian forest	37.459822	-122.295466
R2	Coast live oak riparian forest	37.462636	-122.301926

Appendix F

MEMORANDUM

TO: Alisa Moore, Greg Lyman, Deb Green, Lee Miles, Joyce Hsiao
FROM: Barbara Malloch Leitner
DATE: June 4, 2010
RE: Hesperolinon Confirmation, Boat Ramp and Other Sites
CC: Sonya Foree, Diane Renshaw, Natasha Dvorak, Tom Roberts

On June 3, 2010, Toni Corelli (curator of the San Jose State University herbarium and former SFPUC plant consultant), Sonya Foree and I met in the field with Niall McCarten, the author of the *Hesperolinon* treatment in the *Jepson Manual*. The purpose of the trip was to get confirmation on the identity of the Hesperolinon on the edge of Crystal Springs Reservoir, where it would be impacted by the Lower Crystal Springs Dam Improvements Project, and in the Fountain Thistle Management Area, where mitigation would be carried out.

Last year, Diane Renshaw, a San Mateo botanical expert, and I visited all the sites mapped as *Hesperolinon congestum* by ENTRIX along the water's edge, mapped new localities within and near the Habitat Reserve Program boundaries, and also visited a confirmed locality for HECO at Edgewood Park and in San Mateo Canyon. We sent photographs and plant material to Niall McCarten at the time; the plant material somehow never arrived, but Niall tentatively identified the photos from the eastern edge of Crystal Springs Reservoir as *Hesperolinon californicum*, a non-rare species. Toni Corelli reviewed our dry material and concluded it was *H. congestum*, although it should be noted that Toni had dried specimens, while Niall had only photographs.

We felt the best resolution was to look at the material in the field during this year's flowering period, which Niall and Toni kindly consented to do.

Niall gave the unequivocal opinion that the populations at the Boat Ramp (both in the LCSDI and HRP project areas) and at Edgewood were *Hesperolinon congestum*. By extension, the other known populations on the east side of Crystal Springs Reservoir and in San Mateo Canyon are also HECO—the CSSA work area Deb asked us to look at; the population in San Mateo Canyon; Pulgas Ridge; and all of the populations mapped by ENTRIX in their surveys for LCSDI, as they all possess similar characteristics. Niall also stated that the only other Hesperolinon known from the area is *H. micranthum*, which has a very much smaller flower.

No changes are needed to any of the analysis in any of the environmental documents for LCSDI, the technical memorandum for HRP Peninsula watershed, CSPL2, and, presumably, CSSA (I am not familiar with these documents in detail).

Niall offered some ideas about managing Hesperolinon. It thrives on bare mineral (serpentine) soil. This can be accomplished by burning and scraping, as well as by wave action. There already is a HECO population practically under the Monterey pines in the HRP site, so creating bare soil next to it (while keeping the population intact) could be an ideal way to increase occupied habitat.

U.S. Fish & Wildlife Service
Sacramento Fish & Wildlife Office
Species Account
FOUNTAIN THISTLE
Cirsium fontinale var. fontinale

CLASSIFICATION: Endangered
Federal Register Notice 60:6671; February 3, 1995
http://ecos.fws.gov/docs/federal_register/fr2779.pdf (125 KB)

This species was listed as endangered by the California Department of Fish and Game in July 1979. The California Native Plant Society has placed it on List 1B (rare or endangered throughout its range).

Fountain Thistle
J. E. (Jed) and Bonnie McClellan
© California Academy of Sciences

CRITICAL HABITAT: Not designated

RECOVERY PLAN: Final
Recovery Plan for Serpentine Soil Species of the San Francisco Bay Area; September 30, 1998.
http://ecos.fws.gov/docs/recovery_plan/980930c_v2.pdf (22 MB)

5-YEAR REVIEW: Started March 25, 2009
http://www.fws.gov/policy/library/E8-4258.html

DESCRIPTION

Fountain thistle is an herbaceous perennial of the aster family (Asteraceae). It has several stout, erect reddish stems 30 to 60 centimeters (1 to 2 feet) high. The basal leaves are 10 to 20 centimeters (4 to 8 inches) long with spine-tipped lobes; the leaves on the stems are smaller.

Flowers are dull white to pinkish, becoming brown with age. The egg-shaped, recurved bracts beneath the flower head distinguish fountain thistle from the most similar thistle in the area, brownie thistle *(Cirsiurn quercetorurn)*.

C.f. var. fontinale is a perennial, flowering from June to October. It is thought to be pollinated by. Seed production may be quite low. The species may hybridize with *Cirsiurn quercatorurn*.

Habitat is restricted to perpetually moist clay openings in riparian or serpentine chaparral between about 90 and 190 meters (300 to 600 feet) in elevation. Associated introduced species include English plantain (*Plantago lanceclata*), pampas grass (*Cortaderia selloana*), and wild oat (*Avena fatua*)

SERPENTINE SOIL PLANTS:

Serpentine soils are formed from weathered volcanic (ultramafic) rocks such as serpentinite, dunite, and peridotite. These soils provide a harsh environment for plant growth. Several factors contribute to the inhospitability of serpentine soils to plant growth

1) Low calcium-magnesium ratio;

2) Lack of essential nutrients such as nitrogen, potassium, and phosphorous; and

3) High concentrations of heavy metals (mineral toxicity).

However, serpentine plant species have adapted to serpentine soils and require them to survive.

See the recovery plan (above) for more information about serpentine soil species.

Contact the Coastal Branch of our office (formerly the Coast-Bay-Delta Branch) at 916-414-6625 for consultations concerning serpentine soil species.

The Bay Checkerspot Butterfly PDF | RTF is an insect that depends on serpentine soil plants, primarily dwarf plantain (*Plantago erecta*).

DISTRIBUTION

Historically, this plant occurred in both San Mateo and Santa Clara counties, but it is now found in only four locations in San Mateo County.

U.S. Geological Survey 7.5 Minute Quads: Palo Alto (428B) 3712242, Woodside (429A) 3712243, San Mateo (448D) 3712253.

THREATS

Fountain thistle is threatened by proposed recreational development, roadside maintenance, competition with non-native plant species and garbage dumping. See the recovery plan (above) for more information.

REFERENCES FOR ADDITIONAL INFORMATION

General references about California plants
www.fws.gov/sacramento/es/plant_spp_accts/plant_references.htm

Kruckeberg, A.R. 1984a. California serpentines: Flora, vegetation, geology, soils, and management problems. University of California Press, Berkeley, California. 180 pp.

_____. 1984b. The flora on California's serpentine. Fremontia 11(5): 3-10.

Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825
Phone (916) 414-6600
FAX (916) 414-6713

Last updated August 27, 2009

U.S. Fish & Wildlife Service
Sacramento Fish & Wildlife Office
Species Account
MARIN DWARF-FLAX
Hesperolinon congestum

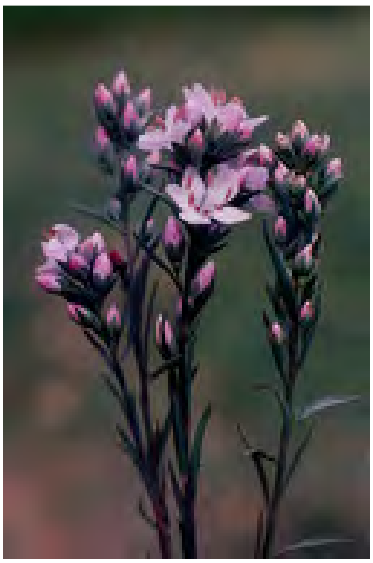
CLASSIFICATION: Threatened
Federal Register Notice 60:6671; February 3, 1995
http://ecos.fws.gov/docs/federal_register/fr2779.pdf (125 KB)

This species was listed as endangered by the California Department of Fish and Game in June 1992 under the name Marin western flax. The California Native Plant Society has placed it on List 1B (rare or endangered throughout its range), also under the alternate name.

CRITICAL HABITAT: Not designated

RECOVERY PLAN: Final
Recovery Plan for Serpentine Soil Species of the San Francisco Bay Area; September 30, 1998.
http://ecos.fws.gov/docs/recovery_plan/980930c_v2.pdf (22 MB)

5-YEAR REVIEW: Started March 25, 2009
http://www.fws.gov/policy/library/E8-4258.html



Marin Dwarf-Flax
© 1997 Doreen L. Smith

DESCRIPTION

Marin dwarf-flax, (*Hesperolinon congestum*), also known as Marin western flax, is a herbaceous annual of the flax family (Linaceae). It has slender, threadlike stems, 10-40 cm (4-16 inches) tall. The leaves are linear.

Marin Dwarf-Flax
© 2007 Toni Corelli

Flowers bloom from May to July. They are borne in congested clusters. Pedicels are 1 to 8 mm (0.04 to 3.2 inches) long Sepals are hairy and the five petals are rose to whitish.

Anthers are deep pink to purple. This helps distinguish Marin dwarf-flax from California dwarf-flax (*H. californicum*), found in the same geographic area, which has white to rose anthers, as well as hairless sepals.

Two other species that are found in the same region are small-flower dwarf-flax (*H. micranthum*) and slender dwarf-flax (*H. spergulinum*).

See Hickman (1993) in General Information about California Plants, below, for a detailed description of these species.

SERPENTINE SOIL PLANTS:

Serpentine soils are formed from weathered volcanic (ultramafic) rocks such as serpentinite, dunite, and peridotite. These soils provide a harsh environment for plant growth. Several factors contribute to the inhospitability of serpentine soils to plant growth

1) Low calcium-magnesium ratio;

2) Lack of essential nutrients such as nitrogen, potassium, and phosphorous; and

3) High concentrations of heavy metals (mineral toxicity).

However, serpentine plant species have adapted to serpentine soils and require them to survive.

See the recovery plan (above) for more information about serpentine soil species.

Contact the Coastal Branch of our office (formerly the Coast-Bay-Delta Branch) at 916-414-6625 for consultations concerning serpentine soil species.

The Bay Checkerspot Butterfly PDF | RTF is an insect that depends on serpentine soil plants, primarily dwarf plantain (*Plantago erecta*).

DISTRIBUTION

Marin dwarf-flax is found on serpentine soils from Main County south to San Mateo County, a range of 80 kilometers (50 miles). Known populations occur between approximately 30 and 370 meters (100 to 1,200 feet) altitude.

U.S.G.S. 7 ½ Minute Quads: Palo Alto (428B) 3712242, Woodside (429A) 3712243, San Mateo (448D) 3712253, San Quentin (466B) 3712284, San Francisco North (466C) 3712274, San Rafael (467A) 3712285, Bolinas (467B) 3712286, Petaluma River (484A) 3812225, San Geronimo (484C) 3812216, Novato (484D) 3812215

THREATS

Marin dwarf-flax is threatened by residential and recreational development, foot traffic, and competition with non-native species

REFERENCES FOR ADDITIONAL INFORMATION

General references about California plants
www.fws.gov/sacramento/es/plant_spp_accts/plant_references.htm

Kruckeberg, A.R. 1984a. California serpentines: Flora, vegetation, geology, soils, and management problems. University of California Press, Berkeley, California. 180 pp.

_____. 1984b. The flora on California's serpentine. Fremontia 11(5): 3-10.

Sharsmith, H.K. 1961. The genus *Hesperolinon* (Linaceae). University of California Publications in Botany. 32:235-314. .

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Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825
Phone (916) 414-6600
FAX (916) 414-6713

Last updated September 21, 2009

Appendix G

Boat Ramp Mitigation Site Invasive Plant Species Control Schedule																												
Task	2010		2011				2012				2013				2014				2015				2016			
	S	F	W	SP	S	F	W	SP	S	F	W	SP	S	F	W	SP	S	F	W	SP	S	F	W	SP	S	F
Burning*																										Y
Mowing**		Y				Y		Y																		
Grazing***				Y				Y	Y			Y	Y			Y	Y									
Herbicide application		Y			Y	Y	Y	Y		Y	Y	Y														
Inasive specie/undesirable natives mechanical removal		Y	Y			Y																				
Inasive specie hand removal		Y	Y	Y	Y	Y	Y	Y			Y	Y			Y	Y			Y	Y						
Drill Seed						Y		Y		Y																
Plant natives						Y	Y			Y				y												
Irrigate****						Y																				
monitor and report							Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

*Burining is included as a longterm mangemetn option and can only be initiated once conditional permits are secured and should only occur after fall rains,

** Mowing in late February through April has been successful in coastal areas; A second summer mowing in June or late spring

*** Grazing will not occur in the oak woodland, riaprian, or wetland areas after planted has commenced

****Irrigatation should not be nessesary for the USMC site water after initial planting