San Francisco Public Utilities Commission
CONCEPTUAL RESTORATION AND REVEGETATION PLAN
(*FINAL*)

LOWER CRYSTAL SPRINGS DAM IMPROVEMENTS PROJECT

Prepared for:

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San Francisco Public Utilities Commission
Conceptual Revegetation and Restoration Plan
Lower Crystal Springs Dam improvements Project

SFPUC Water Enterprise, Natural Resources and Lands Management staff, are aware of the following Conceptual Revegetation and Restoration Plan (Plan) and agree to oversee its implementation as described, including monitoring and reporting, unless otherwise agreed to by the appropriate regulatory resource agencies. Implementation funding, through the contractor's "warranty period", will be provided via the individual WSIP project budget. The SFPUC Water Enterprise, Natural Resources and Lands Management Division, will fund post-warranty implementation to meet site restoration requirements.

for 9/20/10

Tim Ramirez — Date
Manager, Natural Resources & Lands Management Division

Debbie Craven-Green — Date
Regional Permitting Manager, Bureau of Environmental Management

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1. Project Background and Location

The Conceptual Restoration and Revegetation Plan (CRRP) describes treatments and methods to restore habitats temporarily disturbed during implementation of the Lower Crystal Springs Dam Improvements (LCSDI) project.

The LCSDI project contains two components. The main component, Lower Crystal Springs Dam, is located on San Mateo Creek in unincorporated San Mateo County, California, as shown in **Figure 1**. It is approximately 12 miles south of the city of San Francisco and 3 miles west of the city of San Mateo. The dam forms Crystal Springs Reservoir, which lies west of Interstate 280. The second component is the Pulgas Discharge Channel Sampling Station #5 (also depicted on Figure 1) located at the southernmost portion of Upper Crystal Springs Reservoir.

The contents of the report are divided into four main sections:

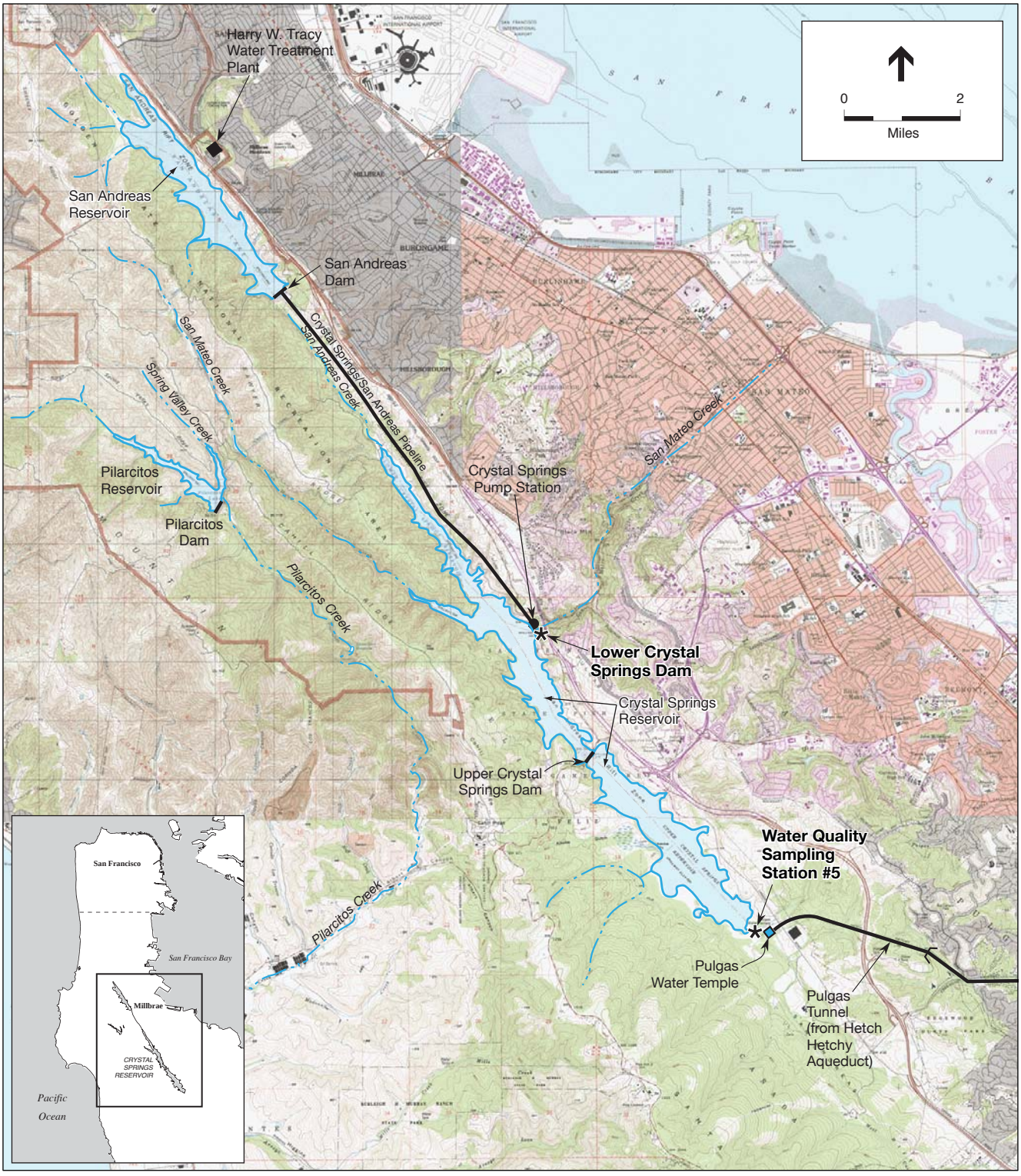
- Section 1: Provides a brief summary of the project.
- Section 2: Defines the project area and its components.
- Section 3: Presents the existing vegetation at the site.
- Section 4: Provides details of the CRRP, including goals of the CRRP, treatment options, maintenance and remedial actions, success criteria and reporting requirements.

The San Francisco Public Utilities Commission (SFPUC) proposes to modify the existing Lower Crystal Springs Dam (LCSD) and the Crystal Springs Reservoir, which is owned and operated by the SFPUC as part of its regional water system. San Francisco's regional water system serves approximately 2.4 million people in the San Francisco Bay Area. Crystal Springs Reservoir is formed by LCSD. In 1983, the California Department of Water Resources, Division of Safety of Dams (DSOD) restricted the amount of water the SFPUC could store in Crystal Springs Reservoir because of concerns that the dam could be damaged during a very infrequent but large flood known as the Probable Maximum Flood (PMF).[1] The SFPUC is required to implement the LCSD improvement project to lift the DSOD-imposed restriction on storage in order to restore lost water storage in Crystal Springs Reservoir.

The DSOD order requires that the SFPUC take one of three actions:

- Demonstrate that the dam as it currently exists can safely pass the PMF;
- Construct hydraulic improvements that would enable the dam to safely pass the PMF; or
- Adopt further restrictive operating procedures that would enable the dam (as it currently exists) to safely pass the PMF.

[1] The PMF is calculated using estimates of the Probable Maximum Precipitation contained in *Probable Maximum Precipitation for California, Hydrometeorological Report No. 58 and 59*, National Oceanic and Atmospheric Administration, 1998 and 1999.



* Proposed Project

SOURCE: ESA + Orion; USGS 1978

Lower Crystal Springs Dam Improvements Project

Figure 1
Project Location

Also as part of the proposed project, the SFPUC will raise Sampling Station #5 at the Pulgas Discharge Channel by about five feet. Water from the Alameda Creek watershed and Tuolumne River enters Crystal Springs Reservoir at its south end through the Pulgas Discharge Channel. Sampling Station #5 is mounted over the channel at elevation 287.5 feet, and the SFPUC uses it to measure water quality flowing through the channel. This sampling station was built at the time the DSOD restrictions were set, and it would need to be modified to continue proper functioning once the LCSDI project is implemented.

1.1 Project Purpose

The overall project purpose is to bring the LCSD into compliance with DSOD requirements. The basic project purpose is to retrofit the dam to accommodate the PMF. The proposed improvements would enable safe passage of the PMF over LCSD. The dam spillway would be widened, its crest would be reshaped and raised, the parapet wall would be raised, and a new stilling basin would be built at the toe of the dam to replace the existing stilling basin. Under the proposed project, post-construction operations of Crystal Springs Reservoir would generally be the same as current operations, except that the maximum normal water surface elevation would be four feet above its current level.

2. Area of Potential Effects

Project components resulting in temporary impacts to San Mateo Creek and associated riparian habitats are summarized below. Installation of the new stilling basin will result in approximately 1.11 acres of temporary impacts to riparian and wetland habitat (0.08 to riparian forest and 1.03 to willow scrub wetlands) at the base of the dam. The raising of Sampling Station #5 at the Pulgas Discharge Channel will result in approximately 0.001 acres of temporary impacts to willow scrub wetland habitat at Sampling Station #5. **Table 1** summarizes temporary impacts on jurisdictional wetlands associated with the LCSDI Project. In addition to jurisdictional areas, restoration of upland staging areas will be addressed in this plan. Loss of oak woodland has not been specified, but the loss of specific individual oak trees will be compensated by plantings, to be specified in this plan.

TABLE 1
TEMPORARY PROJECT IMPACTS ON JURISDICTIONAL AREAS

	Temporary		
Feature	**Square feet**	**Acres**	**Linear Feet**
Stilling Basin			
Riparian forest	3,390	0.08	113
Willow scrub wetland	44,966	1.03	249
Sampling Station #5			
Willow scrub wetland	50	0.001	
TOTAL	**48,406**	**1.11**	

2.1 Components at the Base of the Dam

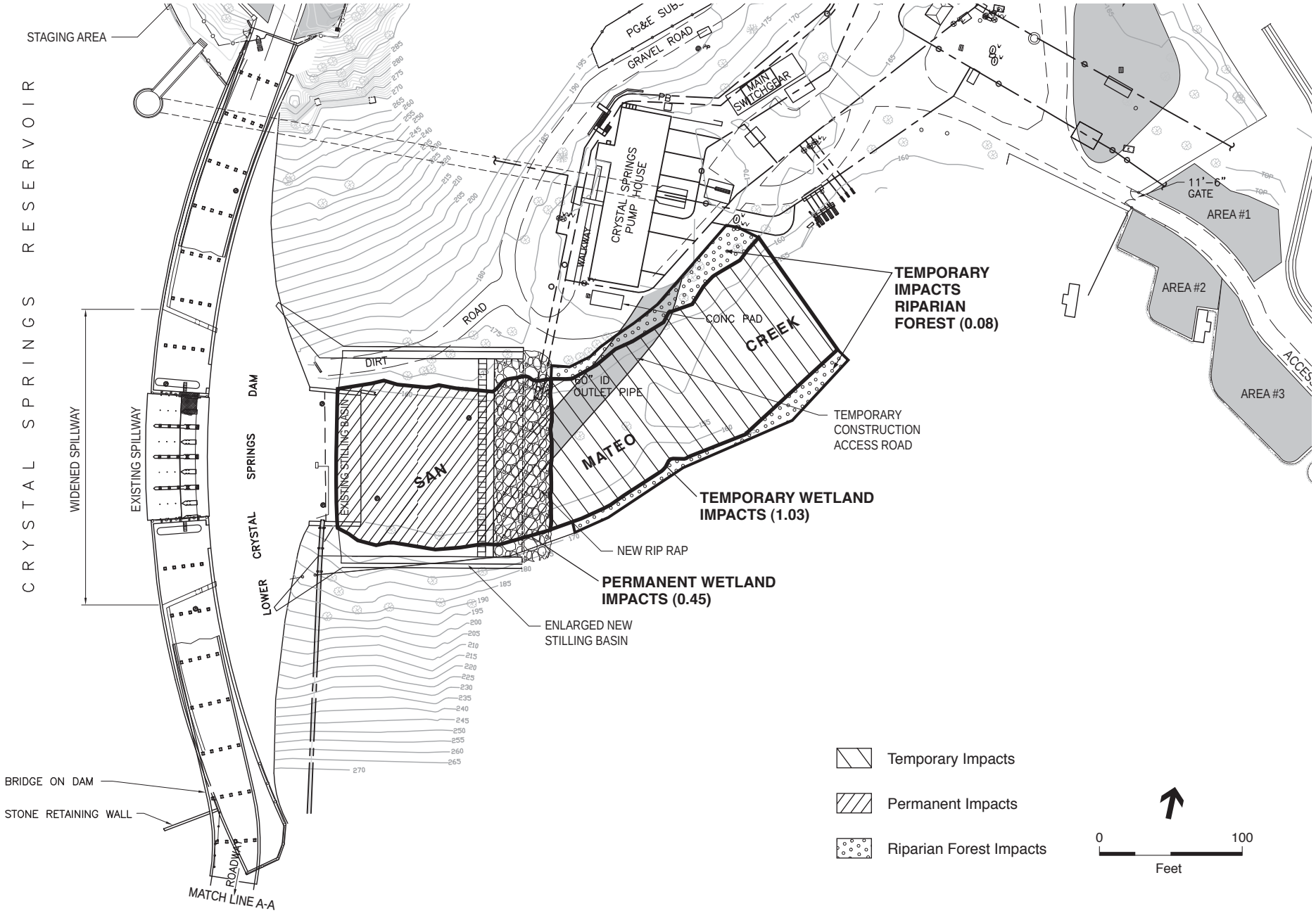
Temporary impacts to San Mateo Creek and associated riparian habitat will occur with the construction of the new stilling basin as summarized in Table 1. Approximately 0.08 acres of riparian forest and 1.03 acres of willow scrub wetland, or a total of 1.11 acres of jurisdictional habitat, would be temporarily impacted during installation of the new stilling basin. **Figure 2** illustrates the temporary impacts on jurisdictional areas associated with this project component. Under the proposed project, the existing 102-foot wide by 32-foot long stilling basin at the toe of Lower Crystal Springs Dam would be demolished. A new concrete stilling basin would be built. The new stilling basin would be 154 feet wide extending along the toe of the dam and 125 feet long.[2] A line of concrete sill blocks perpendicular to the direction of water flow would be built within the stilling basin near its downstream end.

Within the 125-foot long stilling basin, the 20-foot section of the basin downstream of the concrete sill blocks would contain grouted riprap. The riprap would be sealed into place with concrete poured between the rocks to hold it in place. Immediately downstream of the new stilling basin, additional grouted riprap would be installed on the bottom and along the sides of the San Mateo Creek channel. The grouted riprap in the creek channel would extend for 20 linear feet beyond the downstream end of the stilling basin. Combined with the 20 feet of grouted riprap in the new stilling basin, this additional creek bank protection would result in a total of 40 linear feet of grouted riprap.

To access the project area, a temporary construction road for construction vehicles and equipment would be constructed near the location of the existing 60-inch outlet pipe. Vegetation, including trees, would be cleared along a 200-foot long corridor through the riparian area and stream channel near the toe of the dam between the existing access road near the Crystal Springs Pump Station and the site of the new stilling basin for installation of this temporary access road. Mature trees would be saved where it is feasible. The temporary engineered fill gravel road would be built in the cleared corridor; it would be about 35 feet wide at the base and 14 feet wide at the top requiring about 600 cubic yards of engineered fill.

All vegetation including trees within the footprint of the enlarged stilling basin and its associated riprap and within a 10-foot wide buffer around the footprint would be removed. Some upland (non-jurisdictional) habitat would be affected within the buffer area, potentially including some coast live oaks (*Quercus agrifolia*). Non-native grassland with scattered shrubs would also be removed at Staging and Storage Area 1 (no trees would be removed). It is expected that up to 28 trees with a diameter at breast height (dbh) of 12-inches or greater would be removed at the base of the dam, although the SFPUC would make decisions on-site with the contractors about which trees would be removed. The SFPUC intends to save as many mature trees as possible. The dbh (if greater than 4 inches) and species of any trees removed will be recorded and documented in as-built drawings.

[2] The permanent impacts on wetlands associated with this project will be compensated off-site and are not addressed in this plan.



Lower Crystal Springs Dam Improvements Project

Figure 2

Permanent and Temporary Impacts

Construction equipment and materials would be brought to the stilling basin site using the temporary access road that would extend across the creek channel. The floor of the basin would be formed with concrete. Forms for concrete for the wing walls and side walls of the stilling basin would be erected and reinforcing steel fixed in place. Prior to construction of the new stilling basin, the existing stilling basin area, Pool 1[3], and the intervening shallow channel/marsh section would be dewatered through the use of pumps. The sides of the excavation pit for the new stilling basin would be shored during construction, and all groundwater that surfaces in the stilling basin excavation sites (e.g., through weep holes in the shoring) would be pumped and treated prior to discharge to San Mateo Creek. The discharge would occur in accordance with requirements from the SFRWQCB.

2.2 Pulgas Discharge Channel

Impacts at Sampling Station #5 include 50 square feet of temporary impacts to willow riparian for removal and replacement of the sampling station (Table 1). **Figure 3** illustrates the potential temporary impacts resulting from this project component.

3. Existing Vegetation

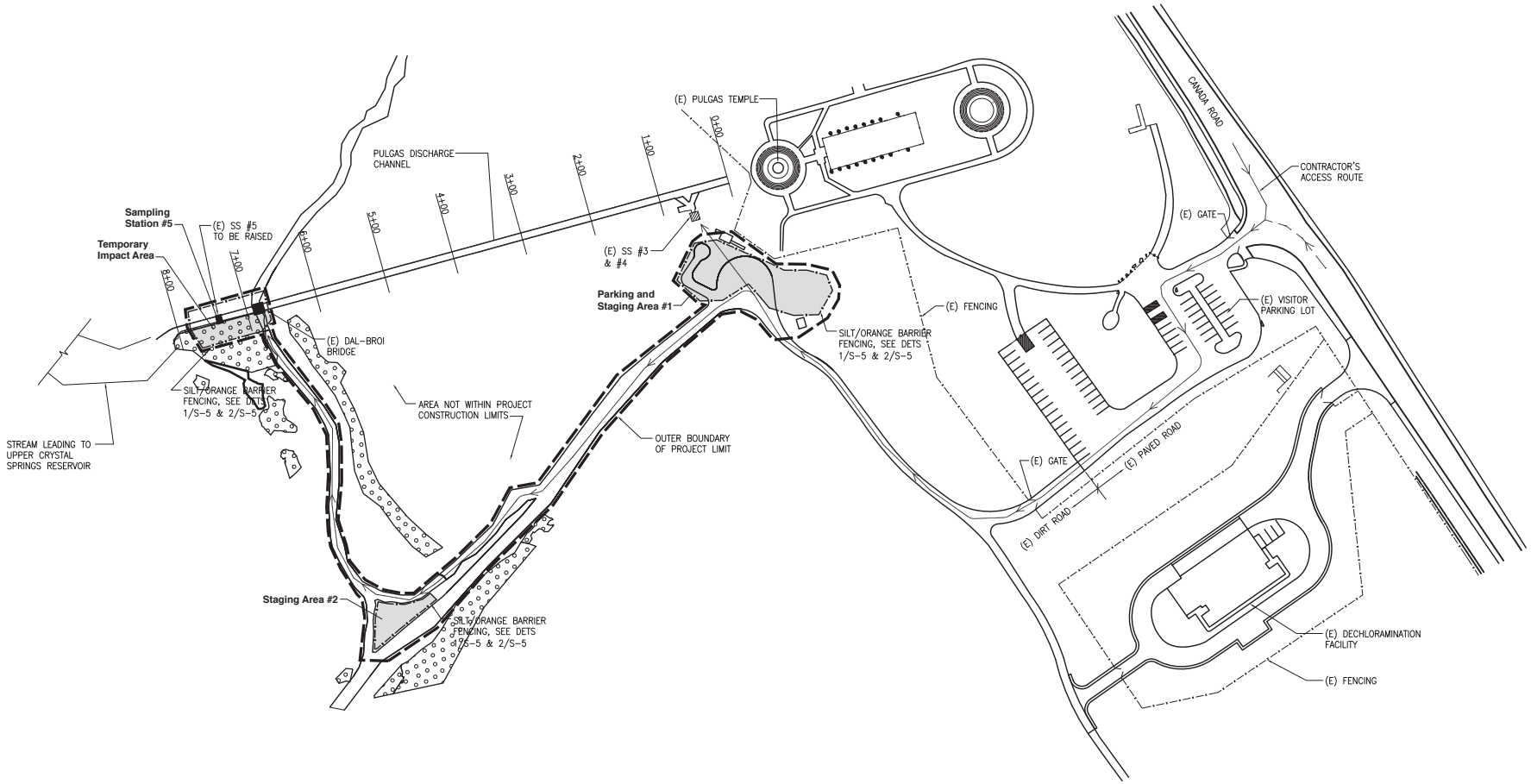
Vegetation communities within the project area downstream of LCSD and Sampling Station #5 are dominated by riparian, grassland, and developed land.

3.1 Wetland and Riparian Areas

The riparian forest in the project vicinity consists of a mixed canopy of black cottonwood (*Populus balsamifera* ssp. *trichocarpa*), big-leaf maple (*Acer macrophyllum*), California bay (*Umbellularia californica*), and Oregon ash (*Fraxinus latifolia*), along with arroyo willow *(Salix lasiolepis*) and other willow species. This mixed riparian community is termed Central Coast riparian forest by Holland (1986) and is found on the floodplains and streambanks of larger, permanently-flowing rivers in the Central Valley and Coast Ranges of California.

Willow scrub wetland areas in the project vicinity are similar to the Central Coast riparian scrub described by Holland (1986). This riparian scrub is a scrubby, upland streamside thicket, varying from open to impenetrable and dominated by various willow species (*Salix* spp.) Central Coast riparian scrub is a dense riparian forest associated with river corridors, seeps, and other wetlands. Within the project area, downstream of the dam most of the riparian vegetation is composed of dense stands of willow monotypes, including sandbar willow (*Salix exigua*) and arroyo willow (*Salix lasiolepis*). Below the LCSD, willows dominate the riparian corridor. At Sampling Station #5 willows occur adjacent to the work area to raise the sampling station. These areas are considered jurisdictional wetlands (rather than riparian), but because of their community structure they are given the term willow scrub wetland in this plan, acknowledging both their wetland jurisdictional status and their willow scrub community structure.

[3] At the toe of Lower Crystal Springs Dam, San Mateo Creek contains two pools where the creek widens and deepens. Pool 1 is located downstream of the existing stilling basin where the existing 60-inch reservoir outlet pipe discharges, and Pool 2 is located downstream of Pool 1 where the ten existing facility outfall pipes are located.



SFPUC Lower Crystal Springs Dam Improvements

Figure 3

Site/Staging Area Plan

Other wetland areas within the project vicinity and downstream of the dam include coastal and valley freshwater marsh, as described by Holland (1986). The coastal and valley freshwater marsh community is dominated by perennial, emergent monocots such as cattail (*Typha* spp.) and bulrushes (*Scirpus* spp.). Vegetation is typically 2 to 5 feet tall, with a closed canopy. This community occurs in permanently flooded, fresh water sites that are lacking a significant current (Holland, 1986). Small areas of coastal and valley freshwater marsh too small to map are interspersed with willow scrub wetland vegetation in the area below the dam.

3.2 Non-native Grassland

The non-native grassland community includes a heterogeneous mix of non-native grasses, annual forbs, and wildflowers. With a few exceptions, the plants are dead through the summer-fall dry season, persisting as seeds. This community type is distributed throughout the valleys and foothills of most of California (except for the northern coastal and desert regions). Dominant species within the non-native grassland areas consist of wild oat (*Avena fatua*), ripgut brome (*Bromus diandrus*), barley (*Hordeum* spp.), and fescue (*Vulpia* spp.). Herbaceous forbs and wildflowers include fiddleneck (*Amsinckia* spp.), shortpod mustard (*Hirschfeldia incana*), filaree (*Erodium* spp.), and yellow star thistle (*Centaurea solstitialis*). Non-native grassland is found throughout the project area and contains a scattering overstory of sycamore trees (*Platanus racemosa*). Downstream of LCSD, non-native grassland occurs above the banks of San Mateo Creek, in areas surrounding the existing pump station facilities, and in the staging areas. Non-native grassland occurs adjacent to the work area at Sampling Station #5.

In the absence of fire or other disturbance, shrubs typical of northern coyote bush scrub (Holland, 1986) tend to invade grasslands found in the moist coastal conditions such as those found at the project site. As a result, non-native grasslands often contain sparse coyote bush (*Baccharis pilularis*), poison-oak (*Toxicodendron diversilobum*), bush monkey-flower (*Mimulus aurantiacus*) and coffeeberry (*Rhamnus californicus*), among others.

3.3 Coast Live Oak Forest

Coast live oak forest is generally strongly dominated by a single species, coast live oak (*Quercus agrifolia)*. It is found in a range of situations in the Coast Ranges, where it is the most abundant and widespread forest type. In sheltered canyon slopes and higher stream terraces such as those found in the project area, typical associated trees include California bay, big-leaf maple, and madrone (*Arbutus menziesii*). The understory is variable, depending on canopy cover, soil depth, and slope. Typical species in San Mateo Creek canyon include poison-oak, California blackberry (*Rubus ursinus*), and an assortment of other native woody species that contribute small amounts of cover. Coast live oak borders the riparian forest and developed portions of the project site. Although some coast live oak individuals may be removed during construction of the project, they will be compensated by replanting of oaks alone rather than by restoration of the natural community, since the losses will consist of isolated individuals.

4. Conceptual Revegetation Plan

The CRRP describes possible treatments that may be used to restore areas temporarily disturbed by construction activities during the LCSDI project. Not all treatments provided in this CRRP may be necessary; therefore not all may be used. The specific treatments to be applied will depend on the type and extent of habitat disturbance at the completion of construction activities.

The CRRP outlines treatment options and planting plans to be implemented at the project site. The goals of this Plan include:

- Perform pre-site clearance invasive plant clearance, as needed, and baseline documentation of existing vegetation conditions
- Return affected areas to pre-project conditions including pre-project habitat conditions and hydrologic functions
- Provide revegetation of habitats temporarily disturbed by construction activities
- Provide slope stability and erosion control through the implementation of revegetation and restoration activities
- Provide monitoring and maintenance to ensure riparian, wetland and upland buffer habitats are reestablished in areas temporarily affected by construction activities
- Maintain compliance with regulatory agreements and permit conditions.

4.1 Pre-site Clearance

This CRRP will be implemented by a qualified restoration firm capable of securing plant materials, installation, maintenance (including weed control), monitoring, and reporting. Most likely, but not necessarily, the firm would be separate from the construction contractor. The services of the restoration firm will be secured a minimum of 6 months before completion of construction to ensure an adequate supply of locally-native plant materials for planting.

Prior to site clearance, the restoration contractor will photo-document the site, quantitatively document existing canopy and understory cover within the planting zones to establish a baseline for species composition and for success criteria dealing with percent vegetation cover. The methods to be used to establish a baseline for photomonitoring and vegetation cover are described in Section 4.8, *Monitoring Methods*.

Prior to site clearance, the restoration contractor will survey the site for invasive plant species that could interfere with restoration efforts or that could spread as a result of construction activities, and will remove them from the revegetation area.[4] Not all invasives require removal before construction, but the following are specifically to be removed, if present: jubata grass (*Cortaderia*

[4] Invasive plants are defined as any species appearing on Tier 1 of the California Regional Water Quality Control Board Fact Sheet for Wetland Projects (http://www.waterboards.ca.gov/sanfranciscobay/certs.shtml) or species listed by the California Invasive Plant Council with an overall rating of "high" (www.cal-ipc.org)

jubata), pampas grass (*Cortaderia selloana*), Cape ivy (*Delairea odorata*), and fennel (*Foeniculum vulgare*). Infestations are believed to be relatively limited in the project area and may not require treatment prior to site clearance. Other invasives will be managed during the restoration phase.

4.2 Overall Restoration

Temporarily affected areas along San Mateo Creek and adjacent to Sampling Station #5 will be recontoured to approximate natural site contours. All native trees and shrubs with a diameter at breast height (dbh) greater than 4 inches removed due to construction activities will be replaced at a minimum 3:1 ratio with local native riparian vegetation. The numbers of each species of tree and shrub will not be defined until site clearance is complete, when they will be recorded on as-built drawings.

In an effort to avoid impacts to the project itself related to tree root growth, willows will not be planted immediately adjacent to newly constructed features such as the stilling basin and down-stream erosion control riprap.

For shrubs and sapling trees under 4 inches dbh, replacement plantings will also be at an approximately 3:1 replacement ratio. Shrubs and trees may be planted no closer than 15 feet from the new stilling basin, to avoid impacts caused by root growth and reduce the need for maintenance. Suggested tree and shrub species are provided in **Table 2**. Two planting zones are identified in Table 2: Riparian Forest, consisting of riparian forest found on the streambanks; and Willow Scrub Wetland, found on the lower floodplain and channel of San Mateo Creek. A third planting zone, Herbaceous, will be addressed separately as it does not include the use of container stock.

As indicated in a previous section, if coast live oaks in upland areas are removed in the construction buffer near the new stilling basin, they will be replaced, inch for inch of dbh, according to standard protocol, primarily in temporary-use construction areas where non-native ornamental trees are removed. As a result, restoration specifications are not developed for planted coast live oaks, but their survival and maintenance will be tracked as part of this CRRP.

"Long" 1 gallon container stock is specified for trees in both the Riparian Forest planting zone and the coast live oak replacement plantings because this container size allows for greater root development, thereby increasing chances for survival post-planting.

The approach for each planting zone will be briefly described in the paragraphs that follow.

Riparian Forest Planting Zone

The Riparian Forest planting zone will restore areas of riparian forest lost during construction. This zone is situated on the streambanks of San Mateo Creek. The primary tree species to be used in restoration of this zone include black cottonwood, California sycamore, Oregon ash, and willows, as well as some of the upland species tolerant of some riparian conditions—big-leaf

TABLE 2
SUGGESTED PLANT SPECIES, BY PLANTING ZONE, FOR REVEGETATION

Common Name ***Scientific Name***	**Planting Zone**	**Spacing**[a]	**Container Size**
Trees			
Big-leaf maple *Acer macrophyllum*	Riparian	10 feet	Long 1 gallon
California bay *Umbellularia californica*	Riparian	10 feet	Long 1 gallon
Coast live oak Quercus agrifolia	Upland[b]	as needed	Long 1 gallon or 5 gallon
Black cottonwood *Populus balsamifera* ssp. *trichocarpa*	Riparian	10 feet	Long 1 gallon or pole cuttings
California sycamore *Platanus racemosa*	Riparian	10 feet	Long 1 gallon
Arroyo willow *Sailx lasiolepis*	Riparian, Wetland	5 feet	Pole cuttings
Red willow *Salix laevigata*	Riparian, Wetland	5 feet	Pole cuttings
Sandbar willow *Salix exigua*	Riparian, Wetland	5 feet	Pole cuttings
Shining willow *Salix lucida*	Riparian, Wetland	5 feet	Pole cuttings
Total Estimated Plantings	*36 trees and 1,795 willows*		
Shrubs and Herbaceous Perennials			
Blue elderberry *Sambucus mexicana*	Riparian	15 feet	Dee-pot or 1 gallon
California gooseberry *Ribes californicum*	Riparian	5 feet	Dee-pot or 1 gallon
Creek dogwood *Cornus sericea ssp. sericea*	Riparian	5 feet	Dee-pot or 1 gallon
Mugwort *Artemisia douglasiana*	Riparian	5 feet	1 gallon
California blackberry *Rubus ursinus*	Riparian	5 feet	Plugs/dee-pots
Total Estimated Shrubs/Perennials	*125 plants*		

[a] Spacing indicates maximum planting density. Actual tree density will also depend on the number and species of trees removed, which will be replaced at a minimum ratio of 3:1.
[b] Coast live oaks will be replaced on an inch per inch basis for oaks >4 dbh in temporary construction areas.

maple and California bay. At a minimum, the trees to be planted will provide at least a 3:1 ratio of replacement trees to those lost with a dbh of at least 4 inches. The understory plantings will consist of blue elderberry, California gooseberry, creek dogwood, mugwort, and California blackberry in proportions approximating those of the original vegetation.

Because the Riparian Forest planting zone is only 0.08 acres, the planting density for trees will be 10-foot centers. This spacing will accommodate the installation of 36 trees, and will provide compensation for 12 mature trees, estimated amount of trees to be removed in this zone. As indicated in a previous section, the species of the replacement plantings will determine when the species composition of lost trees is ascertained.

Willow Scrub Wetland Planting Zone

The Willow Scrub Wetland planting zone will restore areas of existing willow scrub lost during construction in the San Mateo Creek canyon and at Sampling Station # 5. The primary species to be used in restoration of this zone is arroyo willow, the most common willow in the project area. Other willow species will also be used, as available and more or less in proportion to those lost. Black cottonwood may also be planted in this zone. Planting in this zone will consist of installation of pole cuttings.

As indicated in Table 2, the planting density for the willow scrub planting zone downstream from the stilling basin will be 5-foot centers, or one willow pole per 25 square feet. Since the Willow Scrub Wetland is 1.03 acres, this planting zone will receive 1,795 such plantings, and compensate for the loss of existing willow trees at a ratio far in excess of 3:1.

At Sampling Station #5, the area proposed for temporary construction impact is only 50 square feet. To compensate for the loss of willows at this site, willow poles will be installed at 4- to 5-foot spacing, maximizing the plantings within the construction zone by placing them around the periphery of the construction zone, for a total of 5 to 10 plantings.

As indicated in the description of the site, some existing areas of freshwater marsh wetlands are also present within the willow scrub wetland vegetation. Freshwater marsh emergent vegetation tends to establish itself in suitable habitat very quickly. However, the location and extent of suitable habitat for emergent vegetation may be altered as a result of fisheries flow releases after the LCSDI project is completed. As a result, no emergent vegetation will be planted in the Willow Scrub Wetland planting zone, with the expectation that it will quickly colonize suitable habitat without intervention.

Although more upland vegetation sometimes grows on the floodplains of San Mateo Creek, our non-systematic observations of this area indicate that it is underwater frequently and possibly for long periods of time. As a result, we believe that site conditions appear too wet to support upland species, and therefore no upland plantings are proposed for the Willow Scrub Wetland planting zone.

Herbaceous Seeding Zone

The Herbaceous planting zone is proposed for the staging areas and for construction access roads where erosion control is a potential need and reduction in invasive species is required. An herbaceous seed mix for non-native grassland areas is provided in **Table 3**. Herbaceous seeding will be carried out using broadcast seeding methods.

TABLE 3
HERBACEOUS SEED MIX

Common Name[a] *Scientific Name*	**Seeding Rate (lbs/acre)**
Perennial Grass	
Blue wildrye *Elymus glaucus*	5
California brome *Bromus carinatus*	10
Meadow barley *Hordeum brachyantherum*	5
Creeping wildrye *Leymus triticoides*	5
Annual Grass	
Annual fescue Vulpia microstachys	5
Other Herbaceous Species	
Mugwort *Artemisia douglasiana*	1
Sky lupine *Lupinus nanus*	4

[a] Herbaceous seed mix from plantation grown materials with origins as near as possible to site. geographically and ecologically.

4.3 Plant Installation Methods

Container Stock

As indicated in the preceding section, installation of container stock is proposed for the Riparian Forest planting zone and for individual coast live oak plantings as needed to replace lost trees. While adjustments in planting installation and layout may be necessary based on post-construction conditions, minimum spacing requirements and bank position limitations must be adhered to. At the time of planting, flagging will be placed to denote planting sites for individual plants.

- Planting layouts will be finalized in the field. Plant locations and species will be indicated with colored pin flags.
- Planting will adhere to the minimum spacing requirements and planting zone designations as specified in Table 2.
- Any trees planted will be marked with a metal tag loosely attached to a branch of the tree. Tags will specify species by using the first two letters of the scientific name and a unique number for future identification purposes. Example - *Alnus rubra*: ALRU 1.
- The shrubs will be grown in and planted from container-grown plant stock.

- Protective caging will be installed around trees and shrubs (not willows) to shield from wildlife foraging.

- All planting will occur between October 1st (or the onset of the rainy season, if later) and February 1st to take advantage of winter rains and moist soil conditions.

- Plant material will be picked up from a local nursery no more than three days prior to planting. Plant material will be inspected, and any diseased or root-bound stock rejected.

- A 3-inch layer of mulch will be placed around each plant that is above the ordinary high water mark, taking care to avoid the wood crown of the plant. Mulch will be chipped bark or arbor mulch, placed in at least a 1.5-foot circle around each plant. The mulch will help retain moisture and will also serve to control weeds around the plants.

- Planting hole depth for planting trees and shrubs will be 1½ times deeper than the depth of the root ball; planting hole width will be twice as wide as the width of the root ball (**Figure 4**). Slow release fertilizer tablets will be added to each planting hole 2 inches below the surface if deemed necessary based on soil characteristics. Fertilizer tablets with an analysis of 13-13-13 NPK are specified and should not be placed in direct contact with the root ball.

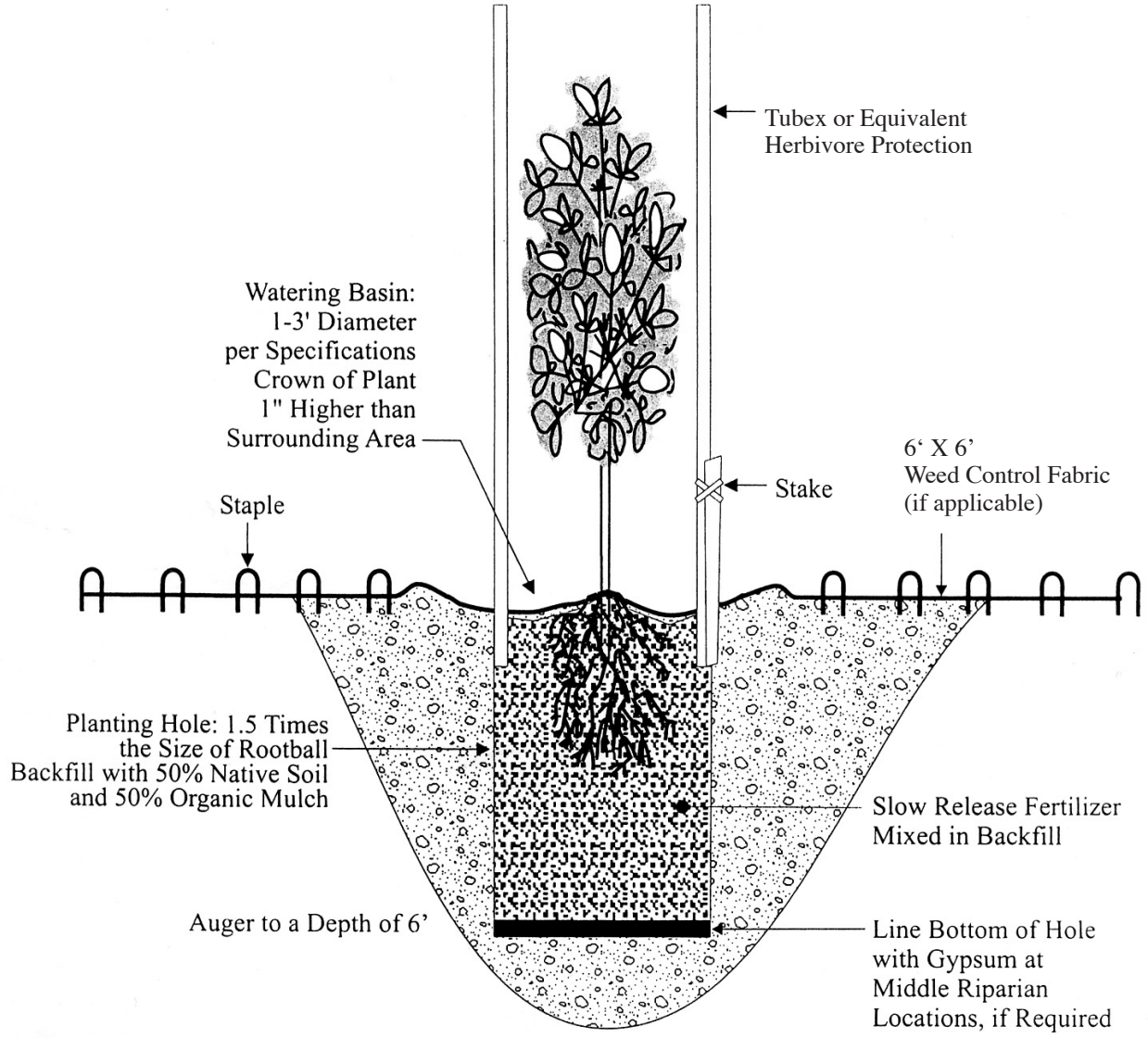
- The holes will be backfilled with pulverized soil from the site, maintaining the crown of the plant slightly above the grade of the soil. The top of the rootball and crown of the plant will not be covered with backfill soil, as the plant will settle after watering to meet the surrounding soil grade.

- The plants will be lightly firmed in place by hand, and a three-foot diameter watering basin will be formed around the plant. Each plant will be thoroughly watered-in, filling the basin with clean potable water. The orientation of each plant will be adjusted if necessary.

Pole Cuttings

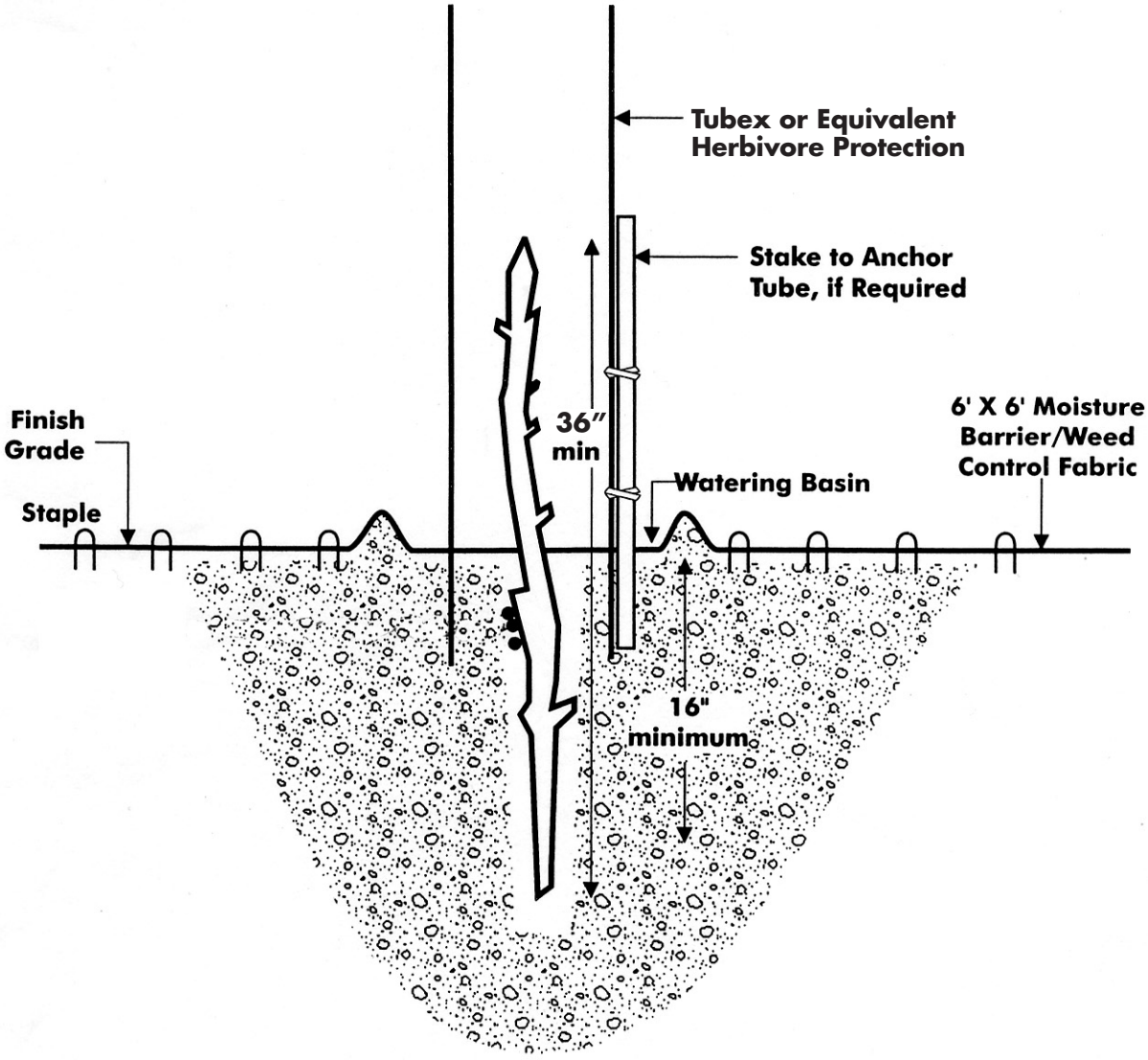
Pole cuttings are proposed for the Willow Scrub Wetland planting zone. Willow poles are cuttings, capable of rooting. They will be taken from healthy individuals, free from disease and injury. They will be 0.5 to 1.5 inches in diameter at the lower end, cut to approximately 5-foot length using a sharp tool, with a 45-degree angle at the lower end and blunt at the upper end. They will be stripped of all stems and leaves, taking care to minimize bruising and damage to the stem. They will be collected while the tree is dormant, well before the buds swell in spring. The pole cuttings will be collected from San Mateo Creek, preferably from the near vicinity of the project. They may be collected no more than two weeks before planting. If collected more than 6 hours before installation, they must be held submerged in clean, fresh water at no more than 50 degrees F.

The timing of installation will be in winter, at a time deemed by the restoration contractor to be appropriate according to local conditions. When planting, care will be taken to place the sharpened and thicker lower end in the soil, with the buds pointing upward. Willow poles may be installed by use of an auger or a punch bar. Eighty percent (approximately 4 feet) of the stake will be installed below-ground, with 20 percent above-ground. The hole should be filled with water and soil, forming a slurry, to remove air pockets (**see Figure 5**).



PLANTING NOTES:
1. PLANTING HOLES TO BE DUG ONE AND A HALF TIMES LARGER THAN ROOTBALL.
2. PROVIDE FOUR INCH DOWNSLOPE BERM TO RETAIN WATER ON SLOPES.

Figure 4
Typical Tree and Shrub
Planting Specifications



PLANTING NOTES:

1. PLANTING HOLE TO BE 24" DEEP X 4" WIDE. SCARIFY SIDES OF HOLE.
2. BACKFILL HOLE WITH WATER-SATURATED PULVERIZED NATIVE SOIL.
3. POLE CUTTINGS TO BE ONE-HALF INCH TO TWO INCH DIAMETER CALIPER BY 48 INCHES LONG, BURY MINIMUM OF 30 INCHES IN HOLE.

Figure 5
Willow Stake Planting Detail

Woody Plant Sources

- Woody plant materials local to the project region will be used.[5] Using plants adapted to local conditions will help ensure the success of restoration and enhancement efforts, and is recognized as the most ecologically sound approach to re-establishment of native vegetation.

  - Seed may be collected from the construction site prior to site preparation and nearby, similar habitats within San Mateo County.
  - Cuttings may be collected from the construction site prior to site preparation and nearby, similar habitats, then placed in pots and maintained while they develop roots. Species suitable for this treatment include any willow species within the vicinity.
  - Divisions or any rooted material may be salvaged from the site just prior to site preparation. Since these materials have roots, they can be held in pots or temporary planting beds for relatively short periods while construction takes place and then planted after construction. Suitable species for salvaging divisions would include California blackberry. To reduce the overall impact of the restoration and to make maximum use of the existing plant materials, priority would be given to divisions taken from the site itself rather than from other local areas.
  - Since willows reliably grow from sprigs placed in moist soil and do not require development of root mass before planting, branches would be collected from nearby willow trees just prior to revegetation.

- If nursery stock is necessary, an experienced native plant nursery will be retained by the SFPUC to provide locally collected plant materials for restoration plantings. Local nurseries that grow native plants on contract the SFPUC may work with for any plant needs associated with LCSDI revegetation efforts include, but are not limited to:

Pacific Coast Seed, Inc.
6144A Industrial Way
Livermore, CA 94550
phone (925) 373-4417
fax (925) 373-6855

Cornflower Farms
P.O. Box 896
Elk Grove, CA 95759
phone (916) 689-1015

Oaktown Native Plant Nursery
P.O. Box 634
Alameda, CA 94501-3824
Phone (510) 534-2552 or (510) 387-9744

North Coast Native Nursery
P.O. Box 744
Petaluma, CA 94953
phone (707) 769-1213
fax (707) 769-1230

Yerba Buena Nursery
19500 Skyline Blvd.
Woodside, CA 94062
phone (650) 851-1668
fax (650) 851-5565

[5] Container stock and pole cuttings are specified to be "locally native plant materials", meaning they have their origins as seed or cuttings taken directly from the near vicinity of the project area and preferably from San Mateo Creek canyon or Upper Crystal Springs Reservoir (in the case of Pulgas Discharge Channel). In general, local plant sources should have their origins within five miles of the project, or at a minimum within San Mateo County. This material can realistically be collected and propagated in the quantities required for this project.

- Ample lead-time in advance of planting is required for nurseries to acquire sufficient quantities of plant material (cuttings and seed), to propagate plants, and to cultivate the plants to be an appropriate size prior to planting. For planting in fall, a lead-time of twelve to fifteen months is ideal to allow for seed collection. For cuttings, which are more expensive and not suitable for all species, a minimum of three months is required.

- During the propagation period, the SFPUC or its representative will visit the nursery at least once to check on the quality of the plant material. Substandard material will be rejected and replaced at the nursery contractor's expense.

Seeding Herbaceous Areas

Upland project work areas with soils exposed by construction activities which are not planned for restoration with woody plant materials will be broadcast-seeded with an herbaceous mix. Such areas include the staging areas below the dam. Herbaceous seeding serves two primary purposes—erosion control and establishing cover to prevent invasives dominance. The seed blend must have a minimum of three locally native grass species[6]. A maximum of two non-native perennial grass species is acceptable as long as the combined seed count of both species is not more than 25 percent of the total seed mix. When used in combination and in small amounts, perennial grasses grow quickly and can serve as a soil adhesive and accelerate nitrogen fixation in the soils.

When no longer needed for this or any other project, the site will be graded to prior topography. Immediately following final grading, and in any case no more than 24 hours following final grading, a native, predominantly grass seed mixture will be applied, either by hand-held application device such as a belly grinder, a rangeland drill, or other suitable device. Immediately following application of seed, the surface will be raked or lightly harrowed to ensure seed coverage. Although this can be done at any time of year, the best time for seed application is in the fall or early winter.

4.4 Replacement Plantings

Replacement plantings should be obtained from local, native vegetation materials, similar to those used initially in restoration. California blackberry and willow can be propagated from onsite species. Shrubs and most forbs should be installed onsite from rooted stock.

4.5 Maintenance and Remediation

Irrigation

Because the project area is located within a naturally shady and damp area, the need for supplemental irrigation is not anticipated. If survivorship is found to be low or water/drought stress is evident in any of the plantings during the monitoring period, supplemental irrigation will be applied as a

[6] By contrast with container stock, the relatively large quantities of seed required for herbaceous seeding are not necessarily readily available commercially, nor can they be propagated in sufficient quantity by local seed collection. Several commercial suppliers have plantation-grown seed, identified by the site where seed was originally collected. These can be reasonably well matched to the site conditions at the project, and such materials are specified for herbaceous seeding.

remedial action at a frequency specified by the project restoration contractor or biologist. If water is not directly accessible at the project site, a water truck or semi-permanent water tank for drip irrigation may be necessary. If plantings show signs of significant drought stress, the monitoring period will be re-set to Year 1 and success criteria will need to be met for at least three years after irrigation has ceased.

Weed Control

It is anticipated that the site will have a substantial growth of weeds directly after restoration activities and throughout the monitoring period. Weed elimination may be an ongoing effort and will require a combination of methods. The restoration contractor will assess the composition of plants growing in disturbed areas to determine if non-native invasive species are present and determine how to control those species accordingly. Only approved weed control methods acceptable within watershed lands will be allowed.

As indicated in an earlier section, invasive species are defined as those considered highly invasive by either the California Invasive Plant Council or the San Francisco Bay Regional Water Quality Control Board. Infestations of plants with high potential to interfere with restoration success or to be spread by construction activities will have been removed prior to site clearance; this is especially applicable to species that spread vegetatively when rhizomes or pieces of rootstock are broken up. Other species may appear from seed stored in the soil, through seed that moves into the site following final grading, or other means. Restored areas will be visited quarterly during the first year and checked for invasive plant infestations. The nature, location and extent of any infestation will be documented, and all individual weeds will be hand-removed when encountered. Careful attention to weed control and hand-removal during the first year is expected to be sufficient. However, any further control actions will be compliant with SFPUC watershed policies, and all regulations governing the use of herbicides in and near waterways.

Plant Maintenance

An adaptive management approach will be applied to the revegetation site. The site will be monitored by SFPUC maintenance crews or designated representatives no less than 4 times per year during the first year (i.e., quarterly), and once a year the following years. The site will be inspected for the following issues:

- Erosion control in place and functioning properly
- Planting sites are not exhibiting water or drought stress (too much or too little water as evidenced by leaf wilt, leaf drop, plant die off)
- Pioneering populations of invasive plants are absent, or are to be treated immediately whenever detected. Existing invasive plant populations are to be removed/treated during each site visits whenever detected
- Distinctive patterns of plant die off will be documented

Remedial Actions

Remedial actions may include some or all of the following:

- Weeding around planting sites to reduce competition from non-native grasses and forbs
- Supplemental watering
- Additional erosion control
- Additional invasive plant control
- Supplemental replacement plantings (may be in-kind or if a particular species is not doing well at the site, a replacement species can be supplemented for the original plant).

Remediation will be undertaken if it appears that the site will not meet the success criteria at the end of the monitoring period. If replacement plantings are necessary to ensure the success criteria are met, plant propagation and installation methods described above will be followed. Replacement plantings, if required, will be installed between October 15 and February 1 to take advantage of the rainy season. Monitoring of the site would be extended to ensure success criteria are obtained for two consecutive years.

4.6 Success Criteria

Revegetation success (or lack of success) is usually readily apparent on the ground but difficult to quantify meaningfully. Percent survival is easy to measure and objective, but cover is more meaningful with regard to habitat value.

Trees

In this assessment, we have proposed the use of survival percentages in the first three years to provide information about whether remedial action is needed. Cover is proposed as a criterion for the third to fifth year, when the habitat values should be well-established. Success criteria for trees will therefore be as follows (**Table 4**):

TABLE 4
SUCCESS CRITERIA FOR PLANTED TREES,
LOWER CRYSTAL SPRINGS REVEGETATION AND RESTORATION PLAN

Monitoring Year	Survivorship of Planted Trees	Percent of Baseline Tree Cover[a]
First year (Fall 2012)	90%	--
Second year (Fall 2013)	80%	--
Third year (Fall 2014)	80%	25%
Fourth year (Fall 2015)		40%
Fifth year (Fall 2016)		75%

[a] Percent cover compared with baseline; for example, if baseline tree canopy is 80 percent, the fourth-year standard for tree canopy cover would be 32 percent.

Woody Understory

In this assessment, we have proposed the use of only cover as a success criterion, because plantings are numerous and some of the most widely-planted species tend to root at the nodes, making the determination of individuals problematic. For this project, understory cover will be measured in the Riparian Forest planting zone. In comparison with the pre-project understory woody plant cover, the success criterion for upland and riparian forest understory will be as follows:

Year 1: 20% of baseline cover
Year 2: 30% of baseline cover
Year 3: 40% of baseline cover
Year 4: 60% of baseline cover
Year 5: 85% of baseline cover

Herbaceous Plant Cover

Success criteria will also include percent cover of non-woody plant species, which includes grasses and grass-like plants, and annual and perennial broadleaf plants in areas seeded with herbaceous species. In comparison with pre-project (baseline) cover of herbaceous areas, such as the staging areas, the cover of herbaceous plant species will be equal to or greater than:

First year (2012) – 10% of baseline cover
Third year (Fall 2014) – 30% of baseline cover
Fifth year (Fall 2016) – 60% of baseline cover

Invasive plants will not be included in this cover estimation.

Erosion

At the end of the five-year monitoring period, erosional features will be absent or will show evidence of successful remediation.

4.7 Monitoring Methods

Monitoring the success of the revegetation and restoration of the Crystal Springs Dam Improvements Project relies on several precepts. First, sampling is carried out at permanent locations. These can be most readily and precisely re-located if they are situated on transects. Uniform spacing of sampling locations (such as quadrats) on transects reduces error, and maximum length (up to 50 m) facilitates speed of sampling. However, an element of randomness must be incorporated into the initial selection of transects, as will be described below.

Second, where sampling (as opposed to censusing) is involved, an adequate sample size must be demonstrated. In this project, the approach to determining adequate sample size is made by plotting the cumulative value of a parameter (such as total canopy cover) versus the number of sample plots to demonstrate that the value has stabilized. A general guideline is to sample 2 percent of the survey area, but the final sampled area could be a larger or smaller proportion

depending on the total size of the restoration area and the degree of heterogeneity of the habitat. When the initial data are collected, the data will be plotted incrementally, by additional plots, against the total number of plots. Once the curve has leveled off, an additional three quadrats will be sampled to confirm that the curve's plateau does not shift.

Third, monitoring will be carried out at the same time or year, to the extent possible. For riparian vegetation in a cool, sheltered canyon, the maximum annual year's growth is likely to be in summer rather than in spring.

Fourth, year-to-year comparison of monitoring sampling results requires statistical analysis. Sampling data from natural vegetation seldom meets the requirement of normal distribution for parametric tests; as a result, this CRRP specifies a non-parametric test, the Wilcoxon signed-rank test, for which the data are likely to meet all requirements. In general, the confidence level will be set at 90 percent.

Establishing Transects

Transects will be the basis for several of the monitoring actions. Due to the dimensions of the restoration area, 50 m transects are the longest dimension that can be accommodated. Two will be placed in the riparian restoration zone, and three (or more, if needed for adequate sample size) in the Willow Scrub Wetlands zone. Three or more will be placed in the herbaceous restoration zone. They will be selected by the observer randomly locating one end of the transect, and fitting the transect within the restoration zone. The transect ends will be marked with t-posts driven into the ground and marked with an aluminum write-on tree tag, with the locations mapped, recorded by GPS, and described in relation to permanent physical features.

Photo-Documentation

Permanent photo locations will be established prior to construction. A minimum of two photo documentation sites per planting zone will be established to document site conditions. The GPS location of the photo documentation site will be recorded to facilitate relocation, and a GIS map created as part of the first monitoring report. The photo documentation points should include landscape features (such as buildings, other structures, and water conveyance improvements) that are unlikely to change over several years so that repeat photos will be easy to position. The placement of a permanent t-post of metal fence post will improve consistency between years, but depending on location these may be installed after final grading rather than pre-construction.

Identical color photographic scenes will be taken each year. The photos can be compared to qualitatively assess changes in general site conditions as well as vegetative composition, cover, dominance, and structure. The following methods should be employed:

- Each photopoint will be numbered with a unique identifier. Photopoint locations will be recorded on a baseline map, and detailed written descriptions with distance and direction to photopoint will be recorded. The compass bearing and distance between the reference and photo points will also be recorded.

- Photo monitoring will be conducted at the same time of year or during the same growth stage (e.g., in full leaf) for the plants being monitored; pictures will be taken at the same camera angle and at approximately the same time of day to the extent feasible.

- Photographs in the field will be documented with the following information: photograph number, photo reference point number, general direction (compass heading) toward object of photograph, reference points, description of surroundings, and other comments that might be helpful in relocation.

Survival of Tree Plantings

During the first three years when survivorship is measured, all container stock trees will be censused in the Riparian Forest planting zone, and all willow pole plantings will be censused in the Willow Scrub Wetland planting zone. In addition, any planted coast live oak or other trees planted in upland construction areas will be censused. Planted material will be considered alive and healthy if it displays noticeable growth, an increase in vegetative cover over time, the presence of new shoots or buds, and shows little or no signs of water stress. Since this assessment is a census and not a sample, no confidence level or confidence interval is required; the percentage of surviving trees in each planting zone will indicate whether performance criteria have been met. If other trees become established naturally from seed or by sucker, these may be included in the census, offsetting any mortality that may occur with the planted plant materials.

The first three years are the period when remedial action should be identified and action taken, to minimize the potential for monitoring for longer than five years. Under some circumstances, survivorship may be lower than the targets, but if plant cover meets the criteria, the revegetation would be considered successful. In fact, vigorous growth of some of the plantings may cause them to outcompete other plantings, yet the revegetation would be a success. On the other hand, if, at the end of the first five years of monitoring, the success criteria are not met, monitoring (and remediation, as necessary) will continue until the fifth-year success criterion is achieved for two consecutive years.

Tree Canopy Cover

Determination of cover percentage in the third to fifth year for trees is more involved. It requires a comparison with the pre-project canopy cover within the Riparian Forest and Willow Scrub Wetland planting zones. We specify the use of a spherical densiometer (ESA+Orion, 2009), with readings taken at 5-meter intervals along the sampling transects, or a smaller spacing if needed to achieve an adequate sample size (as described in the introduction to this section). These data must also be taken in the pre-site disturbance phase. Year-to-year comparisons will be made using the Wilcoxon signed-rank test, as described in the introduction to this section.

Woody Understory Cover

Woody plant understory will be sampled in 1-by-2 meter quadrats located at 5-meter intervals along the randomly-selected transects in the Riparian Forest planting zone. Initial sampling will be carried out prior to site clearance in order to establish baseline cover. The sample size required

for this assessment will be determined pre-site clearance by plotting mean cover versus total sample size, as described in the introduction to this section. Braun-Blanquet cover abundance scale will be used for percent cover intervals (see **Table 5**, below), and the California Native Plant Society cover diagrams will be used as a guide. Total absolute cover will be recorded within each quadrat for each species, as well as for bare earth and litter. Total native and non-native cover will be calculated and presented. A non-parametric test such as the Wilcoxon signed-rank rest will be used to carry out year-to-year comparisons of species richness and native and non-native species cover, with a 90 percent confidence level being the test for significance.

TABLE 5
BRAUN-BLANQUET COVER ABUNDANCE SCALE

Percent Cover Range	Cover Class
>75%	5
50-75%	4
25-50%	3
5-25%	2
>5%	1

Herbaceous Plant Cover

Herbaceous plant cover will be sampled in 1-by-2 meter quadrats located at 5-meter intervals along the randomly-selected transects in the herbaceous planting zone. Initial sampling will be carried out prior to site clearance in order to establish baseline cover. The sample size required for this assessment will be determined pre-site clearance by plotting mean cover versus total sample size, as described in the introduction to this section. Braun-Blanquet cover abundance scale will be used for percent cover intervals (see **Table 5**, below), and the California Native Plant Society cover diagrams will be used as a guide. Total absolute cover will be recorded within each quadrat for each species, as well as for bare earth and litter. Total native and non-native cover will be calculated and presented. A non-parametric test such as the Wilcoxon signed-rank rest will be used to carry out year-to-year comparisons of species richness and native and non-native species cover, with a 90 percent confidence level being the test for significance.

Overall Health and Vigor

General health and vigor of all plantings will be recorded during monitoring, including:

- Evidence of stress from excessive or inadequate water;
- Evidence of disease;
- Evidence of herbivory or burrowing that is causing loss of plants;
- Evidence of erosion of topsoil or exposure of roots.

The following qualitative score will be used to assess the health and vigor of planted stock:

> **Excellent:** No evidence of stress; minor pest or pathogen damage may be present; no chlorotic leaves; no or very minor herbivory. Evidence of new growth, flowering, seed set on majority of plants (>75 % of all plants observed.)
>
> **Good:** Some evidence of stress; pest or pathogen damage present; few chlorotic leaves (>5%), minor evidence of herbivory. Evidence of new growth, flowering, seed set on most plants (>50% of all 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 marks, etc.) Evidence of new growth, flowering, seed set on some plants (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/eaves stripped, etc). No evidence of new growth, flowering and seed set, or only a few plants with these characteristics (less than 25% of plants observed).

In addition, observations will be made for the following:

- Species richness within each planting zone;
- Other site characteristics, such as trespass, hydrologic issues, unusual weather conditions.

4.8 Reporting Requirements

The SFPUC will notify the resource agencies within 72 hours that the restoration has been completed. Post revegetation, an as-built report will be produced to document and represent the post-project planting as-built conditions. The report will provide an overview of the areas were impacted and restored, the restoration methods that employed, number and kind of species planted, and area hydroseeded. The report will be used for conducting and reporting annual monitoring.

The SFPUC will provide the as-built report to the USACE, RWQCB, USFWS, and CDFG within 60 days of completing the restoration. The as-built report will include, but is not limited to: pre and post-project elevation and topography, plant list, restoration methods used, and any changes to the restoration plan that were not anticipated at the time of this report.

Annual monitoring reports will be prepared by the SFPUC and submitted to the resource agencies by December 31st of each year of the five year monitoring period.

5. References

Entrix, Inc./MSE Joint Venture (Entrix/MSE) 2007. *Lower Crystal Springs Dam Improvements Project, San Mateo County, California, Wetlands Determination Report*. Prepared for the San Francisco Public Utilities Commission.

Entrix, *Lower Crystal Springs Dam Project Tree Survey in Construction Area*, memo from Sandee Hufana to Anna Roche, San Francisco Public Utilities Commission, July 8, 2009.

ESA+Orion, *Sunol and Niles Dam Removal Project, Riparian and Wetland Habitat Baseline Monitoring Report*, Prepared for San Francisco Public Utilities Commission, November 2009.

San Francisco Planning Department, *Draft Environmental Impact Report for the San Francisco Public Utilities Commission's Lower Crystal Springs Dam Improvements Project*. San Francisco Planning Department Case No. 2006.0536E. State Clearinghouse No. 2007012002. March 2, 2010.