Pajaro River Bench Excavation Project
Revegetation Plan

Prepared for:

County of Santa Cruz

Department of Public Works

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CHAPTER 1.0 INTRODUCTION

1.1 DESCRIPTION

The Counties of Santa Cruz and Monterey are proposing a bank excavation project to improve the channel conveyance capacity of the Pajaro River. The project extends from Highway 1 upstream 7.5 miles to Murphy's Crossing. Approximately 40 acres of the existing riverbanks will be excavated. An additional 30 acres are estimated to be disturbed by project activities. Two excavation sites are proposed on the Monterey County side; whereas, nine sites are proposed on the Santa Cruz County side of the river.

Phased Construction

Two excavation sites: 1R and 2R are anticipated to be constructed in Phase 1 (summer 2012). The remaining nine excavation sites 3R, 4R, 5R, 5.5R, 6R, 7R, 8R, 2L and 4L are anticipated to be constructed in Phase 2 (spring and summer 2013). The timing and completion of both phases are subject to change and will depend on project logistics, primarily the availability of receiver sites for the excavated soil materials and trucking access.

Each of the excavation sites shall be revegetated to mitigate for the removal of vegetation in the riparian corridor. The entire square footage of each site will be hydroseeded for erosion control and portions planted with native trees, shrubs and herbs. A planting list has been prepared for each of the eleven revegetation areas (see Appendix A and Planting Plan Sheets). The scientific names are according to The Jepson Manual of Vascular Plants of California, 2nd Edition (in press, 2011).

Phased Revegetation Project

The proposed riparian revegetation project will be phased. Erosion control and hydroseeding will occur in fall following grading and hauling work. The majority of proposed willow (*Salix* spp.) and black cottonwood (*Populus trichocarpa*) short cuttings will be planted the first fall and winter after construction. The proposed container stock and live transplants or divisions will be planted the second fall and winter after construction is complete. Following hydroseeding, a Revegetation Contractor (henceforth referred to as the "Contractor") qualified in native riparian restoration will maintain the revegetation areas and their buffers for five years. After a five-year establishment period, maintenance will be transferred to the County of Santa Cruz Department of Public Works.

Under the supervision of the Project Botanist, the Contractor will collect willow and black cottonwood (*Populus trichocarpa*) cuttings along the Pajaro River and nearby sloughs. The County or its agents will provide the native grass seed and Hooker's Primrose seed needed for the hydroseed mix. The County will also provide the contract-grown container stock to the Contractor for planting. A portion of the herbaceous material will

be transplanted by the Contractor from the river channel as divisions, including broad-fruited bur reed (*Sparganium eurycarpum*) and California tule (*Schoenoplectus californicus*). No formal irrigation is proposed; water needed for hydroseeding and planting will be trucked into the revegetation areas.

Managing invasive, non-native vegetation will be a key component for having a successful revegetation program, especially the high priority species listed in Table 1 such as Cape Ivy, giant reed, star thistle, and poison hemlock.

1.2 GOALS AND OBJECTIVES

The proposed revegetation program will focus on increasing the cover of native vegetation to improve the habitat value of the excavated benches and river banks, and their 25-foot wide buffers for improved fisheries and wildlife habitat. Revegetation of the excavation sites will also be an important factor in controlling soil erosion and sediment deposition into the Pajaro River.

Restoration Goals

The primary goals of this Revegetation Plan are to:

- Increase the abundance and diversity of native plant species and the habitat value of the riparian corridor,
- Re-create a natural plant community that will provide optimal habitat for native wildlife, and
- Re-establish native riparian vegetation habitat that will become self-sustaining in the long-term.

Several other goals for the project involve minimizing routine maintenance efforts, minimizing opportunities for noxious weed establishment, and reducing supplemental watering needs. During the five-year establishment period, proper maintenance will be important. When plants are well established, maintenance efforts should be minimal.

Revegetation Objectives

To accomplish the above stated goals, the objectives of this Revegetation Plan are to:

- Restore and manage native riparian forest to promote species diversity, structural diversity, and density along the inner river banks.
- Increase width of riparian corridor, consistent with flood protection needs to provide increased stream shading and in-stream cover for aquatic organisms.
- Enhance native populations of riparian species via exotic plant removal, natural recruitment and active revegetation.

Table 1. Pajaro River Bench Excavation Project
Target Invasive, Non-Native Plants for Removal

Invasive, Non-Native Species		Priority for Control
Common Names	**Scientific**	
Bindweed	*Convolvulus arvensis*	High
Bristly Ox-tongue	*Helminthotheca echioides*	Medium
Bull Thistle	*Cirsium vulgare*	High
Bur clover	*Medicago polymorpha*	Low
Buttercup Oxalis	*Oxalis pes-caprae*	Medium
Cape Ivy	*Delaireia odorata*	High
Common Fennel	*Foeniculum vulgare*	Medium
Cocklebur	*Xanthium strumarium*	Medium
English Ivy	*Hedera helix*	High
Field Mustard	*Brassica rapa*	High
French Broom	*Genista monspessulana*	High
Fullers Teasel	*Dipsacus sativus*	Medium
Giant Reed	*Arundo donax*	High
Himalayan Blackberry	*Rubus procerus*	High
Summer Mustard	*Hirschfeldia incana*	High
Iceplant or Sea Fig	*Carpobrotus edulis*	Medium
Italian Thistle	*Carduus pycnocephalus*	High
Milk Thistle	*Silybum marianum*	High
Pampas/Jubata Grass	*Cortaderia jubata*	High
Perennial Ryegrass	*Lolium perenne*	Medium
Poison Hemlock	*Conium maculatum*	High
Prickly Wild Lettuce	*Lactuca serriola*	Medium
Rabbit's Foot Grass	*Polypogon monspelensis*	Low
Ripgut Brome	*Bromus diandrus*	Medium
Smilo Gras	*Piptatherum miliaceum*	Medium
Velvet Grass	*Holcus lanatus*	Medium
White Sweet Clover	*Melilotus albus*	Medium
Wild Radish	*Raphanus sativus*	Low
Yellow Dock	*Rumex crispus*	Medium
Yellow Star Thistle	*Centaurea soltitialis*	High

* Invasive plant removal will focus on container stock planting basins and the five-foot wide band of vegetation around each planting basin.

1.3 SUBMITTALS

a) Within 7 days of the date following issuance of the Notice to Proceed, provide the Project Engineer with a copy of the Contractor's or Subcontractor's California State Landscape Contractor's C-27 License.

b) Submit a certificate of compliance stating that the bark mulch conforms to these specifications to the Project Engineer for approval before ordering the material.

c) Additionally, obtain certification from the manufacturer that the bark mulch materials are free of the sudden oak death pathogen and *Phytophthora ramorum*.

1.4 QUALITY ASSURANCE

The Contractor or Subcontractor shall hold a California State Landscape Contractor's C-27 License, and have a minimum of 5 years of experience installing riparian projects.

The Project Botanist or Project Biologist will identify cutting collection sites within the Pajaro River watershed and nearby areas, and will oversee all phases of cutting collection, storage, and handling.

The Project Botanist will inspect the quality of the delivered cuttings and container stock to be used for revegetation.

Importance of Using Local Native Propagation Material. Plant performance will be better if container stock that has originated from locally collected propagules (seeds, cuttings, etc.) is used for revegetation, since the propagules have adapted to local environmental conditions. Wherever practical, seeds and cuttings to propagate plants for revegetation will come from the Pajaro River riparian corridor, and nearby areas. Cuttings from shrub species are typically collected in fall for contract growing, and will need to be collected the fall prior to the fall planting. California blackberry cuttings need to be collected in November one year before planting.

Types of Propagules. Principal factors in selecting types of planting stock are adaptability to the site, cost effectiveness, and if local material is available. The kinds of propagules will include: container stock, short cuttings, plant divisions, and seeds. To the maximum extent possible, propagules will be collected or sourced from the Pajaro River watershed. If propagules are not available from the Pajaro watershed, then the collection range may be expanded to riparian corridors in Santa Cruz County. The Project Biologist or Project Botanist should approve all propagule sources in advance of collection. Most of the native species specified for Hydroseed Mix A will be locally sourced from the Pajaro River watershed.

1.5 EROSION CONTROL HYDROSEEDING

The Hydroseed Contractor will conduct the hydroseeding and soil testing for nutrient analysis. The total area of each excavation sitewill be hydroseeded by October 15 the first fall after construction. Two mixes will be applied using the 2-step process. Mix A is composed of sterile wheat (*Elymus* X *Triticum)*, meadow barley (*Hordeum brachyantherum*), California brome (Bromus carinatus), white yarrow (*Achillea*

millefolium) and Hooker's primrose (*Oenothera elata ssp. hookeri)*. Mix B is 100% sterile wheat.

Sterile wheat, slow release fertilizer (11:11:11), and white yarrow (*Achillea millefolium*) and the components listed below will be provided by the Hydroseed Contractor for both Mix A and Mix B; whereas, the County or its agents will provide the locally sourced native grass seed and Hooker's primrose for Mix A.. Sterile wheat may be obtained from Pacific Coast Seed in Livermore, (510) 373-4417). Due to large quantities needed, the sterile wheat seed should be reserved by June 1 prior to the fall hydroseeding.

A slow release fertilizer such as Floricote (11:11:11) will be applied in the hydroseed mix. The application rate will depend on the results of soil testing conducted by the Hydroseed Contractor, and will be finalized by the Hydroseed Contractor and Project Botanist. A range of 250 to 500 lbs. of slow release fertilizer per acre is likely.

Mix A will be applied to the newly constructed 3:1 riverbanks; whereas, Mix B will be applied to the excavated benches. Sterile wheat performs strongly the first year, and allows the site seed bank to respond in subsequent years.

Project access routes and staging areas will also be hydroseeded according to the Construction Plan and Erosion Control specifications.

Conduct Soil Nutrient Analysis

The Hydroseed Contractor will collect soil samples from the excavation sites after construction. Samples will be sent to the Soil Control Laboratory for soil nutrient analysis of nitrogen, potassium and phosphorus. The results will be used to determine the application rate needed for the slow release fertilizer such as Floricote (11:11:11).

Rinsing of Slurry Tank

Prior to applying the mixes, the hydroseed Contractor shall rinse the truck slurry tank with water three times to insure that no seed contamination occurs to the specified seed mixes. The seed mixes listed below will be supplemented with the following ingredients:

Slurry Materials and Seed Mixes

Slurry Materials	**Application Rate (per acre)**
Slow release fertilizer (11:11:11)	250 to 500 lbs
Cellulose fiber mulch	2,000 lbs
Tackifier (Polyacrylamide type)	3 gallons

Table 2. Hydroseed Mixes for Pajaro River Excavation Sites

Hydroseed Mix A (3:1 Banks, total acreage, 11.4 acres) :

Application rate: 52 lbs Mix A per acre

Common Name	Scientific Name	Application Rate
White Yarrow	*Achillea millefolium*	1 lb. per acre
California Brome	*Bromus carinatus*	10 lbs. per acre
Meadow Barley	*Hordeum brachyantherum*	10 lbs. per acre
Sterile Wheat	*Elymus* X *Triticum*	30 lbs. per acre
Hookers Primrose	*Oenothera elata hookeri*	1 lb. per acre

Hydroseed Mix B (level benches, total acreage, 27.7 acres) :

Application rate: 50 lbs Mix B per acre

Common Name	Scientific Name	Application Rate
Sterile Wheat	*Elymus* X *Triticum*	50 lbs per acre

1.6 COLLECTION AND DELIVERY OF PLANTING MATERIAL

Collection of Willow and Black Cottonwood Cuttings (Year 1)

The Revegetation Contractor will collect short cuttings from young trees that have smooth bark, according to the following specifications:

Species	Diameter	Length
Black Cottonwood (*Populus trichocarpa*)	0.75 to 1.5 inches	18 to 24 inches
Red Willow (*Salix laevigata*)	0.75 to 1.5 inches	18 to 24 inches
Arroyo Willow (*Salix lasiolepis*)	0.50 to 1.0 inches	18 to 24 inches
Sandbar willow (*Salix exigua*)	0.50 to 1.0 inches	18 to 24 inches

Select cuttings that are straight, so that the tip to the base does not deviate more than twice the diameter of the cutting. The cuttings should be taken from vigorous stock, free of insects and diseases. Collect cuttings from as many plants as feasible to ensure genetic diversity of the plant material.

Harvest cuttings with sharp pruning shears, lopping shears, small wood saw, or brush cutters. Make cuts with sharp clean tools. Make clean cuts without any additional damage or scaring of parent tree. Do not re-cut harvested cuttings after initial

collection. Remove all side branches and all leaves along the entire length of each cutting to create one single stem.

Delivery and Inspection of Cuttings. The short cuttings shall be transported in buckets of water and planted within 48 hours of harvesting. The cuttings shall be delivered to the project sites by the Contractor. Access to collection sites outside of the work site shall be coordinated with the Project Wildlife Biologist or Project Botanist. Delivery vehicles shall have covered or closed beds to minimize windburn to cuttings during transport. The Contractor shall provide the Project Engineer and Project Botanist with 48-hour advance notice for each partial or complete cutting delivery to the work site.

At the time of delivery to the work site, the Project Engineer or Project Botanist will inspect the cuttings for injury, disease, and insect infestation and ensure that the cuttings are the correct size. Unacceptable cuttings shall be replaced with cuttings of similar size and species before the start of cutting installation, at the Revegetation Contractor's expense. Cuttings not meeting the requirements in this Section shall be immediately removed from the project sites at the Revegetation Contractor's expense and disposed of according to State and local regulations. No additional compensation will be made for any additional expenses incurred by the Contractor as a result of the rejection of cuttings.

Delivery and Inspection of Container Plants. The County will furnish and deliver to the work site all container stock planting materials required for the project. The Contractor shall provide the Project Engineer or Project Botanist with a minimum of 15 days advance notice when requesting delivery of plant materials to the work site. The Contractor shall coordinate with the County and its agents to ensure that all container plants are delivered during the planting season after Construction Phase 1 and Construction Phase 2 from December 1st through March 1st. Otherwise, the Contractor shall be required to pay a storage fee to the nursery. Phase 1 deliveries are estimated to start in December 2013; whereas, Phase 2 deliveries are estimated to start December 2014.

1.7 STORAGE AND PROTECTION

Handling and storage of plants delivered to the site by the County and accepted by the Contractor become the responsibility of the Contractor. All plant materials not installed on the day of arrival at the project site shall be stored and protected. Plant materials shall be maintained in optimal health and protected at all times from animal damage, vandalism, wind, excessive sun, drying out, and any other conditions that would damage or reduce the viability of the plants.

Immediately after removing cuttings from a source plant and bundling, the cuttings shall be maintained cool and moist at all times. Cuttings shall be stored in large, covered containers to conserve moisture. Storage locations shall be subject to the Project Engineer's approval. Cuttings shall be installed within 48 hours of collection.

1.8 MATERIALS

Container Stock

All container plants required for the project will be provided by the County per numbers specified in the planting lists (see Table 3, Master Planting List and Appendix A).

The majority of the container stock, except for bog rush and mulefat, will be planted on the newly excavated 3:1 river banks in order to keep a minimum of 93% of the new benches open for flood capacity (see Section 1.20).

Plant Divisions and Transplants

The Contractor will be responsible for collecting the divisions of wetland species such as sedges and rushes, including tall cyperus and bur reed listed in the planting lists. The number of divisions needed will be coordinated with the Project Botanist/Botanical Monitor, and will depend on the rate of natural recruitment. It is likely that the number of divisions needed for a given revegetation area will be fewer than the quantities in the planting lists presented in Appendix A.

Willow and Black Cottonwood Cuttings

The Contractor will be responsible for collecting and transporting the willow and black cottonwood cuttings. The Project Biologist or Project Botanist will oversee the cutting collection, and will select the collection locations.

Mulch

Mulch shall be clean, nitrogen treated shredded bark or wood chip that is free of disease, invasive weeds and seeds. The name of the supplier and a sample shall be submitted to the Project Engineer for approval.

Water

Water shall be obtained from sources to be determined by the Project Engineer. There will be no formal irrigation system. Supplemental water will be applied using a water truck, hoses and quick coupler.

Table 3. Master Planting List for the Pajaro River (all excavation sites combined) Total Area Bench 27.73 acres; Total Area Bank 11.37 acres

Scientific Names	Common Names	Species Codes	Container Type or Cuttings*	Estimated Quantities	Approximate On-Center Spacing** (feet)	Planting Location
Trees:						
Acer negundo	Box Elder	ACNE	treepot	456	12.0 – 15.0	Mid Bank
Alnus rubra or *rhombifolia*	Red or White Alder	ALRU	treepot	51	12.0 – 15.0	Bench
						Lower Bank
Platanus racemosa	California Sycamore	PLRA	treepot	42	12.0 – 15.0	Lower Bank
Populus trichocarpa	Black Cottonwood	POTR	Short cuttings	643	10.0 – 12.0	Bench
						Lower Bank
Quercus agrifolia	Coast Live Oak	QUAG	treepot, acorn acorns	24	12.0 – 15.0	Upper Bank
Salix spp. (i.e. S. lasiolepis, S. laevigata and lasiandra)	Arroyo, Red, and Yellow Willow	SASp.	short cuttings	2155	8.0 – 10.0	Bench
						Channel Edge
Sambucus nigra	Blue Elderberry	SANI	treepot	90	12.0 – 15.0	Upper Bank
Shrubs:						
Artemisia californica	California Sage	ARCA	1-gallon	528	8.0	Upper Bank
Artemisia douglasiana	Mugwort	ARDO	1-gallon	909	8.0	Mid Bank
Baccharis pilularis	Coyote Brush	BAPI	treepot	420	12.0	Mid Bank
						Upper Bank
Baccharis salicifolia	Mule Fat	BASA	treepot	84	10.0	Bench
Cornus sericea	Creek Dogwood	COSE	treepot	48	10.0 – 12.0	Lower Bank
Frangula californica	Coffeeberry	FRCA	treepot	198	10.0 – 12.0	Mid Bank
						Upper Bank
Rosa californica	Wild Rose	ROCA	1-gallon	474	8.0	Mid Bank
Rubus ursinus	California Blackberry	RUUR	deepot	1827	5.0	Lower Bank
Salix exigua	Sandbar Willow	SAEX	short cutting	130	8.0- 10.0	Bench
						Channel Edge

Scientific Names	Common Names	Species Codes	Container Type or Cuttings*	Estimated Quantities	Approximate On-Center Spacing** (feet)	Planting Location
Perennial Herbs & Grasses:						
Baccharis douglasii	Marsh Baccharis	BADO	1-gallon	264	5.0	Lower Bank
Cyperus eragrostis	Tall Cyperus	CYER	divisions	40	8.0	Bench Channel Edge
Juncus effusus ssp.	Bog Rush*	JUEF	divisions	230	6.0	Channel Edge
Leymus triticoides	Creeping Wild Rye Grass	LETR	1-gallon	489	5.0	Mid Bank
Oenothera elata ssp. *hookeri*	Hooker's Primrose	OEHO	1-gallon	160	4.0	Mid Bank
Bolboschoe-nus fluviatilis	River Tule	BOFL	divisions	136	8.0	Bench
Schoenoplec-tus robustus	Prairie Bulrush	SCRO	divisions	181	8.0	Bench
Schoenoplec-tus californicus	California Tule	SCCA	divisions	435	8.0	Bench Channel Edge
Sparganium eurycarpum	Broad-fruited Burreed	SPEU	divisions	94	8.0	Bench Channel Edge

* The majority of the container plantings (excluding bog rush and mulefat) will be installed on the newly excavated 3:1 banks with the toe of the bank designated for California blackberry (see toe planting zone on the planting plan sheets).

Container sizes: treepots @ 4" by 4" by 14" deep; deepots @ 2.5" by 2.5" by 10 " deep.

** Exact spacing and quantities will need to be field fit for each revegetation area, depending on existing vegetation and rate of natural recruitment. Distances are approximate guidelines.

California blackberry, creeping wild rye grass, and mugwort will be planted 3 per larger planting basin (3 feet by 6 feet).

1.9 PLANT INSTALLATION OF CUTTINGS, CONTAINER STOCK & DIVISIONS

The Contractor will install cuttings, container stock and plant divisions as described in this Section. Cuttings will be planted in Year 1, containers and plant divisions in Year 2. The number of plant divisions specified in the planting lists is subject to change, depending on the results of monitoring for plant recruitment. The number to be planted will be confirmed by the Project Botanist. Planting of cuttings, container stock and plant divisions shall occur after rain has moistened the ground to a depth of 8 inches. Expected installation period would be December 1st through March 1st.

Cuttings

Short cuttings, 18 to 24 inches long shall be installed vertically so that the narrow end is exposed above grade. All cuttings shall be installed with 3/4 of their length below grade (see installation detail on plan sheet D1). At no time shall fertilizer be used for the cuttings. The cutting hole shall be backfilled with moist, pulverized material meeting the requirements specified above. Backfill material shall be tamped in place to completely encircle the cutting and leave no air pockets.

Cuttings shall be of the species, type, and quantity indicated on the planting plan sheets. Cuttings shall be cut at a right angle at the wide end of the cutting. Cuttings shall be collected from sites identified by the Project Wildlife Biologist or Project Botanist, and stored by the Contractor. At the direction of the Project Engineer or Project Botanist, cuttings may be installed below the new bench along the existing willow habitat.

Container Stock & Plant Divisions

Planting material shall be installed at locations shown on the schematic planting plan, matching the quantities listed for each revegetation area (see Appendix A). The majority of the container plantings (excluding bog rush and mulefat) will be installed on the newly excavated 3:1 banks with the toe of the bank designated for California blackberry (see toe planting zone on the planting plan sheets).

The Project Engineer or Project Botanist will confirm proper placement and field fitting. The Contractor shall field mark all planting locations by plant species, before installation for approval by the Project Engineer or Project Botanist. The Contractor shall provide a minimum of 48-hours notice to the Project Engineer in advance of field marking. Planting locations may be modified at the discretion of the Engineer or Project Botanist, if large rocks, tree roots, or other underground obstructions are encountered that interfere with plant installation.

Plant Divisions. Plant divisions are specified in the planting lists for water-loving plants that grow along the water channel, including sedges and rushes. The Contractor will collect the divisions along the Pajaro River channel and transplant them within four

hours to the bench areas as indicated on the Planting Plan Sheets. Field fitting is expected.

Container Stock. Depending on the planting surface, it is expected that the planting hole excavation may require, but may not be limited to, the use of one of the following methods: hand digging, pry bar, or auger. After the holes have been excavated, roughen the inside surfaces of the holes to enable root penetration. Container plants shall be removed from the container with the root ball intact. After removing the plants from containers, scarify each side of the root ball to prevent a root-bound condition. Matted roots on the side of the root ball shall be longitudinally sliced 1/8 to 1/4 inch deep at least once per side. Matted roots on the bottom of the root ball shall be sliced to 1/4 inch deep. Insert the root ball into the planting hole without bending or damaging the roots. Plants shall be set plumb and braced in position until backfill material has been placed and tamped solidly around the root ball.

Planting holes shall be backfilled with native topsoil meeting the requirements specified above. The root ball shall be placed so that the top is 1 inch above the finish grade of the planting basin after settling ones (see installation detail on plan sheet D1).

Sterile straw mulch will be applied onto all bare and seeded areas within the revegetation areas. Straw shall be hand spread to a maximum of two inches after the installation of container stock.

All installed container plants and transplanted plant divisions shall be inspected after installation and watering for settling. If plants have settled, they shall be raised in accordance with this Section.

Planting material shall be installed so that side drainage outlets to the river are not obstructed.

1.10 PLANTING BASINS

In areas where erosion control fabric is not installed, the Contractor shall construct circular planting basins with a 4-inch berm around each plant, as shown on the Planting plan sheets. The planting basins shall be constructed using native soil conforming to the backfill specification in this Section. The planting basins shall be 2 to 2.5 feet in diameter for single plantings, and 6 feet by 4 feet for triple plantings for California blackberry, mugwort and creeping wild rye grass. In areas where a 2-foot diameter basin is infeasible, basins shall be a minimum of 1.5 feet. Soil berms shall be compacted by hand.

In areas where erosion control fabric is installed, in each planting location the Contractor shall cut, fold back, and anchor, the erosion control fabric when forming the planting basin.

1.11 MULCH

The Contractor shall place bark mulch within the planting basins. Mulch shall be placed to an even depth of 3 inches. At no time shall mulch be placed within 4 inches of the plant stem. Mulch shall be kept out of the crowns of shrubs. Bark mulch shall be installed after March 30th to prevent mulch from being washed away during winter storm flows.

1.12 WATERING

Immediately following installation, the Contractor shall thoroughly water all container plants, completely saturating the soil surrounding the plant material. Water shall be trucked to each revegetation area. Plantings shall be hand watered using hoses and quick couplers, or other methods approved by the Project Engineer.

1.13 PLANTING BASIN REPAIR

The planting (watering) basins will be inspected and repaired on a routine basis, so that irrigation water is directed to plant roots and does not contribute to erosion. Most of the repair is anticipated to be on the downslope side of the planting basins.

1.14 PLANT PROTECTION

The Contractor will be responsible for plant protection. Above ground plant protection shelters typically used for deer, using wire netting and rebar are not allowed due to potential vandalism and damage to natural resources. Due to high rabbit populations along the river, browse protection will be placed around selected species immediately after planting. Protection methods include flexible, plastic tree guards that wrap around the stem/trunk or short exclosures made with 1-foot tall rigid plastic anchored to the ground. Custom made gopher baskets with wire lining the planting hole are specified, not prefabricated ones (see installation detail on plan sheet D1). The following species are recommended for browse and gopher protection, so that survival criteria are met: California sycamore, California wild rose, blue elderberry, coast live oak, coffeeberry, creek dogwood, and red or white alder. California wild rose is subject to rabbit damage. Box elder or other species may be added to the protection list, if damage is observed to be a problem during Phase 1 monitoring.

1.15 WEED CONTROL

Weed control shall consist of all work and materials needed to maintain the revegetation areas and their buffers free of weeds and invasive, non-native plant species during the construction period and after plant installation. Maintenance weeding and invasive, non-native plant removal will commence right after hydroseeding the newly constructed benches and riverbanks. Pre-emergent herbicides are not allowed due to the presence of Species of Concern, including Red-legged Frog and Western Pond Turtle. Herbicide use for weed control or invasive plants will be used as a last resort and shall be

approved by the Engineer and Project Biologist prior to application. If herbicide is deemed necessary, spot treatments, basal bark treatments, or cut stump treatments are preferred over broadcast spraying methods. Current herbicide use from levee crest to levee crest is restricted to using Aquamaster for specific projects, and requires prior approval and coordination with the County's IPM Coordinator. Weeds and invasive, non-native plants occurring within the revegetation areas (previous excavation sites) and their buffers will be controlled. Planting basins will be hand weeded.

A 25-foot wide buffer contiguous with the revegetation areas (levee side) will also be maintained. The buffer will be mowed or trimmed to keep non-native vegetation to a maximum of one-foot tall. The timing of any spring mowing or weed trimming will be coordinated with the Project Wildlife Biologist, so that ground nesting birds are not disturbed, and to be in compliance with the Migratory Bird Treaty Act. A target list of invasive, non-native plant species to be removed from the revegetation areas and their adjacent 25-foot buffer is provided (see Table 1). Target invasive, non-native species include Cape Ivy (*Delaireia odorata*), giant reed (*Arundo donax*), poison hemlock (*Conium maculatum*), yellow star thistle (*Centaurea solstitialis*), milk thistle (*Silybum marianum*) and wild radish (*Raphanus sativus*). Weeds throughout the revegetation areas will be kept to a maximum height of 1.0 foot in spring and summer to minimize reseeding of weedy species. Care will be taken to avoid any native woody species that colonize the gaps between plantings.

1.16 AS-BUILT DRAWINGS

The Contractor shall prepare as-built record drawings to document the numbers planted according to species. Changes and species substitution, if necessary, will be approved by the Project Biologist, and will be documented on planting plan sheets.

The As-Built drawings shall be to scale, include any changes, or substitutions, and be a complete record of the project. The Contractor shall provide the County with two sets of newly printed As-built drawings.

1.17 PAYMENT

Full compensation for furnishing labor, materials, tools, equipment and incidentals, and for doing all of the work involved in installing the revegetation areas, weed control, and supplemental planting of replacement cuttings and container stock shall be considered as included in the contract lump sum price paid for revegetation and no separate payment will be paid.

1.18 PLANT GUARANTEE AND REPLACEMENT

The Contractor will be responsible for supplemental or replacement planting of container stock that has died or has performed poorly. Supplemental planting in Fall 2014 through Winter 2016 is likely, if performance criteria are not met. The amount of supplemental planting needed will be assessed during the summer plant survival counts. The replacement planting is only required for plantings that are dead or dying. The Project

Botanist will coordinate with the County to decide on the number of plants, the species, and the container size to be used for the replacement planting. Substitute species may be used if the original species planted performs poorly.

1.19 IMPLEMENTATION SCHEDULES

Implementation schedules for the revegetation program for the Establishment Period and the Long-Term are provided in this report, and include the time of year to hydroseed, plant willow and black cotton wood cuttings, install container stock, and maintain and monitor the revegetation areas. The Establishment Period is estimated to occur over a 6-year period, starting with erosion control measures, hydroseeding and invasive, non-native plant removal. For Construction Phase 1, the Establishment Period will start in late Fall 2012. For Construction Phase 2, the Establishment Period is estimated to start in late Fall 2013.

Construction Schedule. The dates listed in the revegetation implementation schedules (Tables 4 and 5) are subject to change, and assume bench excavation for all of the excavation sites will be completed over a two-year period, starting in summer 2012 and ending in summer 2013. Two excavation sites, 1R and 2R are anticipated to be constructed in Phase 1. The remaining nine excavation sites 3R, 4R, 5R, 5.5R, 6R, 7R, 8R, 2L and 4L will be constructed in Phase 2. The timing and completion of both phases are subject to change, and will depend on project logistics, primarily the availability of receiver sites for the excavated soil materials and trucking access.

1.20 HYDRAULIC ANALYSIS

Hydraulic analysis for the bench excavation project was conducted by Northwest Hydraulic Consultants (NHC). They investigated how much of the newly excavated bench could be planted with woody riparian vegetation in order to be compatible with 5-, 10-, 15-, 25- and 50-year flood events. They determined that the riparian planting width should be less than 7% of the excavated bench width, and calculated the following maximum riparian planting widths for each excavation site, including the sub areas for the larger sites (pers. comm. NHC, 01/17/12):

Site	Max Bench Planting Width	Site	Max Bench Planting Width
1R	5 feet	6R-DS	4 feet
2R	5 feet	6R-US	10 feet
3R	5 feet	7R	5 feet
4R-US	4 feet	8R	4 feet
4R-mid	10 feet	2L	3 feet
4R-DS	4 feet	5.5	4 feet
5R	5 feet	4L	5 feet

This information will guide the limits of tree and shrub planting and maintenance mowing of the newly excavated benches.

Table 4a. Construction Phase 1

Establishment Period
Revegetation Implementation Schedule *

	Year 1 (2012)				Year 2 (2013)				Year 3 (2014)				Year 4 (2015)				Year 5 (2016)				Year 6 (2017)			
TASK	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**
Erosion Control			•				•																	
Hydroseed				•																				
Install Willow and Cottonwood Cuttings				•	•																			
Install Container Stock								•	•															
Maintenance**				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Culling & Thinning											•				•				•				•	
Biological Monitoring				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Prepare Year-end Report					•				•				•				•				•			
Remedial Planting												•	•			•	•							

* Dates listed in the schedule are subject to change, and assume bank construction for all of the excavation sites will be completed over a two-year period. Excavation sites 1R and 2R are anticipated be constructed in summer 2012.

** Provides for five years of maintenance and monitoring commencing after hydroseeding. Maintenance includes watering, weeding, invasive, non-native plant removal, culling, weed trimming and mowing.

Table 4b. Construction Phase 1

Long-Term
Revegetation Implementation Schedule*

	Year 7 (2018)				Year 8 (2019)				Year 9 (2020)				Year 10 (2021)				Year 11 (2022)			
TASK	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**
Exotics Control		•	•			•	•			•	•			•	•					
Mowing & Weed-trimming**		•	•			•	•			•	•			•	•					
Culling & Thinning			•				•				•				•					
Biological Monitoring	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•				
Prepare Year-end Report					•				•				•							
Prepare Final Report																	•			

* Dates listed in the schedule are subject to change, and assume bank construction for all of the excavation sites will be completed over a two-year period, Year 1 (2012) and Year 2 (2013). Excavation sites 1R and 2R are anticipated to be constructed in summer 2012.

** Provides for four years of long-term maintenance and monitoring. Maintenance will also include tree culling and thinning as needed to lower roughness and plant competition.

Table 5a. Construction Phase 2

Establishment Period
Revegetation Implementation Schedule *

	Year 1 (2013)				Year 2 (2014)				Year 3 (2015)				Year 4 (2016)				Year 5 (2017)				Year 6 (2018)			
TASK	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**
Erosion Control			•				•																	
Hydroseed				•																				
Install Willow and Cottonwood Cuttings				•	•																			
Install Container Stock								•	•															
Maintenance**				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Culling & Thinning											•				•				•				•	
Biological Monitoring				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Prepare Year-end Report					•				•				•				•				•			
Supplemental Planting												•	•			•	•			•	•			

* Dates listed in the schedule are subject to change, and assume bank construction for the second phase will be completed in fall 2013. Excavation sites 3R, 4R, 5R, 5.5R, 6R, 7R, 8R, 2L and 4L are anticipated to be constructed in the second phase.

** Provides for five years of maintenance and monitoring commencing after hydroseeding. Maintenance includes weeding, invasive, non-native plant removal, watering, culling, weed trimming and mowing.

Table 5b. Construction Phase 2

Long-Term
Revegetation Implementation Schedule*

	Year 7 (2019)				Year 8 (2020)				Year 9 (2021)				Year 10 (2022)				Year 11 (2023)			
TASK	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**	**W**	**S**	**S**	**F**
Exotics Control		•	•			•	•			•	•			•	•					
Mowing & Weed-trimming**		•	•			•	•			•	•			•	•					
Culling & Thinning			•				•				•				•					
Biological Monitoring	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•				
Prepare Year-end Report					•				•				•							
Prepare Final Report																	•			

* Dates listed in the schedule are subject to change, and assume bank construction for all of the excavation sites will be completed over a two-year period, Year 1 (2012) and Year 2 (2013). Excavation sites 3R, 4R, 5R, 5.5R, 6R, 7R, 8R, 2L and 4L are anticipated to be constructed in the second phase.

** Provides for four years of long-term maintenance and monitoring. Maintenance will also include tree culling and thinning as needed to lower roughness and plant competition.

CHAPTER 2.0 MAINTENANCE ACTIVITIES

2.1 DESCRIPTION

Maintenance of the revegetation areas and their 25-foot wide buffers (on the levee side) will start after installing erosion control measures and the initial hydroseeding. Maintenance activities will include controlling invasive, non-native species, weeding, supplemental truck watering, mowing, weed trimming, remedial planting, debris removal, and thinning and pruning the installed trees and shrubs. Each of the 11 revegetation areas (bank excavation sites) plus a 25-foot wide buffer on the levee side of the revegetation area will be maintained and mowed and/or weed-trimmed to control invasive, invasive non-native species.

The majority of the work described in this section will be performed by the Contractor under separate contract. The County's maintenance staff will assist with mowing the buffers, once in spring and once in late summer (see Mowing Section).

2.2 SUBMITTALS

a) Within 7 days of the date of the Notice to Proceed, provide the Engineer with a copy of the Contractor's or Subcontractor's California State Landscape Contractor's License.

b) Submit a schedule specifying maintenance visits, and listing authorized workers and vehicles.

c) Submit a certificate of compliance stating that the bark mulch conforms to these specifications to the Project Engineer for approval before ordering the material.

d) Additionally, obtain certification from the manufacturer that the bark mulch materials are free of the sudden oak death pathogen and *Phytophthora ramorum*.

Throughout the maintenance period, the Contractor shall record all weed control, replanting, and other maintenance activities performed monthly using a form similar to the example included in Appendix B. The Contractor shall submit the completed forms to the Project Engineer within 10 days following the end of each month.

The Contractor shall provide the Project Engineer with an adjusted watering schedule if the application rates and frequency vary from what is described in this section.

2.3 MAINTENANCE SCHEDULE

Maintenance of the revegetation areas and their 25-foot buffers will start after installing erosion control measures and the initial hydroseeding. The mitigation plantings will be maintained regularly during the 5-year plant establishment period. The plant establishment period and associated site maintenance will be extended if significant plant replacement is required due plant mortality.

2.4 QUALITY ASSURANCE

The Contractor or Subcontractor shall hold a California State Landscape Contractor's License and have a minimum of 5 years revegetation maintenance experience in riparian habitat.

The Project Biologist or Project Botanist will identify replacement cutting collection sites, if necessary, within the Pajaro River riparian corridor and adjacent sloughs for the Contractor prior to cutting collection.

The Engineer will oversee all phases of cutting collection, storage, and handling.

Personnel performing weed control shall be trained to identify native plant species installed as part of the contract.

Due to the presence of the rare Red-legged Frog and the Western Pond Turtle, herbicides are not to be used in the revegetation areas, buffers or flood plains along the river corridor.

All tree thinning and pruning shall be overseen by the Project Botanist.

Before final acceptance of the project and filing of a Notice of Completion for the project, the Contractor shall post a performance bond covering against defects of the plantings for one year after final acceptance of the project by the County.

2.5 PAYMENT

Full compensation for furnishing labor, materials, tools, equipment and incidentals, and for doing all of the work involved in maintaining the revegetation areas, weed control, and supplemental planting of replacement cuttings and container stock shall be considered as included in the contract lump sum price paid for revegetation maintenance.

2.6 MAINTENANCE TASKS

Plant Maintenance

Maintenance Frequency. The Contractor shall check each planting location a minimum of once every week during the irrigation season (March to October) and a minimum of once every month during the non-irrigation season (November to February) for the duration of the maintenance period. During the watering season, the Contractor shall examine plant condition, weed growth, planting basin stability, and assess soil moisture around each plant to ensure that the plants are receiving sufficient water. During the non-irrigation season, the Contractor shall also remove any flood debris that may be covering plants. The Contractor shall record all maintenance activities and observations in monthly Maintenance Log (see Appendix B Maintenance and Monitoring Forms).

Supplemental Watering. The Contractor will provide supplemental watering during the 5-year plant establishment period. The plants will be watered using a water truck. Two gallons of water per plant is estimated and will be verified by the Project Biological Monitor. Due to the high vandalism potential along the Pajaro River and a resident homeless population, a formal irrigation system with irrigation bubblers is not deemed feasible due to potential theft and incidental breakage. In Year 1, the container stock plantings will be watered approximately three times per month, from April through October, to keep the soils within the root zone moist. The watering schedule in Year 2 will be reduced (approximately two times per month). In Year 3, little irrigation (one time per month) will be required. The watering schedule described above is a guideline, and may be adjusted after monitoring revegetation performance.

Repair of Planting Basins: The planting (watering) basins will be inspected and repaired on a routine basis, so that water is directed to plant roots and does not contribute to erosion. Most of the repair is anticipated to be on the downslope side of the planting basins.

Mulching. The Contractor shall replace bark mulch within the planting basins to maintain the depth and coverage specified in plant installation.

Pruning. The Contractor shall selectively prune, on an as-needed basis under the direction of the Project Botanist, to remove dead and broken branches and to correct structural defects. The Contractor shall prune plantings according to their natural growth characteristics leaving trees well shaped and balanced. All pruning debris shall be disposed of offsite by the Contractor according to local and state regulations.

Culling or Thinning. Tree thinning or culling will be conducted under the direction of the Project Botanist. The Contractor shall be responsible for culling of new plants should plant densities exceed success criteria specified in the Monitoring and Reporting Section of this report. Culling shall be performed to reduce competition between plantings. The Contractor shall cut the trunk or main stem of the plant in the root tissue

below grade. Trees with severe storm damage or very poor form may also be culled out. Culling operations may be required periodically during the maintenance period at the direction of the Project Botanist. All culling debris shall be disposed of offsite by the Contractor according to local and state regulations.

Plant Replacement. The Contractor will be responsible for supplemental or replacement planting of container stock that has died or has performed poorly. Supplemental planting in Fall 2014 through Winter 2017 is expected. The amount of supplemental planting needed will be assessed during the summer monitoring and survival counts conducted by the Project Botanist. Supplemental replacement planting is only required for plantings that are dead or dying, and plant survival criteria have not been met. Losses or damages to plantings due to herbivory, disease, pests, vandalism, or high storm flows shall also require replacement, if the site exceeds allowable mortality rate.

The Contractor shall not be responsible for replacement or repair costs associated with vandalism, flooding, or other acts of nature (e.g., damage by wildlife).

Plant Survival Criteria for Container Stock

First Fall after Planting: The target survival rate for all plants in a revegetation area is 100%. If monitoring results determine that percent survival is less than 100%, all of the dead and dying plantings shall be replaced by the Revegetation Contractor.

Second Fall after Planting: The target survival rate for all plants in a revegetation area is 90%. If monitoring results determine that the percent survival is less than 90%, the minimum number of plants required to achieve the 90% survival criterion shall be replaced by the Revegetation Contractor.

Third Fall after Planting: The target survival rate for all plants in a revegetation area is 80%. If percent survival is less than 80%, the minimum number of plants required to achieve the 80% survival criterion shall be replaced by the Revegetation Contractor.

The biological monitor will coordinate with the County to decide on the number of plants, the species, and the container size to be used for the replacement planting. Credit for natural recruitment will also be factored into determining the number of replacement plantings. Substitute species may be used if the original species planted performs poorly. The Contractor will record the number and location of the remedial or supplemental plantings on the As-built drawings. All dead plants shall be disposed of offsite by the Contractor according to local and state regulations.

Cutting Replacement

Replacement cuttings shall be the same species and size as those being replaced, unless otherwise directed by the Project Botanist. Cuttings will be replaced if monitoring results determine that cutting survival is less than 70% of that planted. If percent survival is less than 70%, the minimum number of plants required to achieve the 70% survival criterion shall be replaced by the Contractor.

The Contractor shall collect the replacement cuttings as specified. The Contractor shall not be responsible for replacement cutting costs unless it is determined by the Project Engineer that plant mortality was the result of Contractor negligence, in which case the Contractor shall be financially responsible for replacement cuttings.

2.7 WEED CONTROL

Weeds within the revegetation areas (previous excavation sites) and their buffers will be controlled around each plant and throughout the revegetation areas as a whole as part of the weed trimming and mowing program. A target list of invasive, non-native plant species to be removed from the planting basins and around the plantings is provided (Table 1). The watering basin around each installed tree and shrub will be hand weeded; whereas the areas around the basins may be maintained by weed trimming, and the upper banks and a 25-foot wide buffer on the levee side of the revegetation areas may be mowed and mulched with wood chips to keep weed levels down. Weeds throughout the revegetation areas will be kept to a maximum height of 1.0 foot in spring and summer to minimize reseeding of weedy species. Care will be taken to avoid any native woody species that colonize the gaps between plantings.

Criteria. The Contractor shall control weeds in all planting areas (as indicated on the drawings) throughout the work site during the maintenance period in accordance with these specifications and all local regulations. Maintenance activities shall include weed control within the planting basins, as well as herbaceous vegetation clearing, exotic tree removal, resprout eradication, and noxious weed control (as specified in this Section) throughout the planting areas. Weed control criteria shall consist of the following:

Maintaining all planting basins and an area 5 feet in diameter around each plant, free of weeds during the duration of the maintenance period. Weeds that grow within 5 feet of each planting, including in the planting basin and on the berms, shall be removed before the weeds reach 6 inches in height, or cover 30% of the planting basin or equivalent area. Weeds shall be removed before they produce viable seed.

Controlling herbaceous vegetation in the revegetation areas outside of the area specified above, but within the planting areas (as indicated on the drawings). Herbaceous vegetation shall be removed in these areas before vegetation exceeds 1.0 foot in height.

Noxious Weed Control. The Contractor shall eradicate existing noxious weeds and invasive, non-native plants within the planting areas. Prior to the start of any eradication activities, the Contractor shall stake or flag the control locations in the field for approval by the Project Botanist.

Control Methods. Weed control shall include hand-pulling, mechanical removal, and herbicide application as described below. The methods used shall be dependent on the location of weeds and the time of year that weed control operations occur. Installed plants and native plant volunteers shall not be damaged by weed control operations. Hydroseeded grasses occurring within the planting basins and on the basin berms shall be treated as weeds.

Hand-pulling: All weed control within the planting basins or within 24 inches of any seedling shall be performed by hand-pulling or using hand tools. Weed removal shall not cause disruption to the root system or the above-ground structure of the plants or planting basins. Contractor shall remove, within planting basins, only those plants that were not installed as part of the contract.

Mechanical control: Weed control within the planting areas, outside of the planting basins, shall be conducted using mechanical methods (e.g., mower, weed trimmer). Weeds shall be cut at, or below ground level, to maintain weeds at a maximum height of 6 inches. At no time shall mechanical methods be used to control weeds within the planting basins.

Herbicide application: As a last resort, control of some weeds may require herbicide application. Work shall be conducted only after receiving approval from the Project Wildlife Biologist. Herbicide application shall be limited to cutting and painting stumps, or foliar or spot spray using backpack or ATV-mounted sprayers. Current herbicide use from levee crest to levee crest is restricted to using Aquamaster for specific projects, and requires prior approval and coordination with the County's IPM Coordinator. Herbicide will be applied according to manufacturer's specifications by licensed applicators in a manner that minimizes drip and drift into the stream channel. Herbicides shall only be used in the planting areas to control noxious weeds. At no time shall herbicides be used to control weeds within the planting basins.

Disposal of Removed Invasive, Non-native Plant Material

In general, the removed material of most of the vines and species with underground stems (e.g., Bermuda grass, periwinkle, Himalayan blackberry, bindweed, Kikuyu grass, and Cape ivy) will need to be removed off-site, and taken to the green waste at a sanitary landfill. Such species can reproduce from stem fragments, so they should not be dragged over soil surfaces, but bagged or contained as close as possible to the area from where they were removed. Invasive, non-natives with mature seed such as French broom, thistle species, bristly ox-tongue, yellow dock, and acacias should also be taken to the landfill. If not in seed, larger acacias may be cut and used as firewood.

Follow-up Monitoring and Control of Invasive, Non-Native Species

Since it is very difficult to remove all of an infestation of invasive, non-native species at once, it is important to conduct follow-up monitoring by re-visiting the site several months after exotic plant removal. Any resprouts should be removed. Species such as periwinkle, Cape ivy, Kikuyu grass, and bindweed that have underground stems/ runners are especially likely to resprout. French broom also tends to persist in areas due the fact that its seed stays viable in the soil "seed bank" for over 40 years. Due to the heavy infestations along the Pajaro River, invasive, non-native species removal is likely to be an on-going part of maintaining the riparian corridor. Note that many of the invasive species have propagules that are transported in the river water from infested areas further up in the watershed.

The revegetation areas will be surveyed for problematic invasive, non-native vegetation as part of site monitoring as described in the Monitoring and Reporting Section of this report. Surveys for invasive non-native vegetation should be concentrated during the winter and spring months. The performance criteria listed recommend a maximum of 10% relative vegetative cover of invasive, non-native plant species.

Mowing and Weed Trimming

Mowing and/or weed trimming of the revegetation areas and their 25-foot wide buffers will start the first spring after bench excavation, and will continue throughout the 5-year establishment period. The majority of the work described in this section will be performed by the Contractor. The County's maintenance staff will assist with mowing portions the revegetation areas and buffers, once in April and once in late September. At the end of Year 5, the Project Biologist will determine how much more mowing or weed trimming will be needed for the next five years, and make recommendations for a long-term mowing program for the project site. Any spring mowing or weed trimming will be done under the direction of the Project Wildlife Biologist to ensure that ground nesting birds and Western Pond Turtles are not disturbed.

Depending on weather patterns, it is estimated that the ground vegetation will need to be cut at 3 to 4 week intervals during the growing season, so that the herb layer does not exceed 1.0 foot in height. This will lower weed seed production and competition with the plantings for soil moisture. In Year 1, mowing may be used on the top half of the new 3:1 banks with care taken not to damage erosion control measures such as coir rolls and erosion control blankets. After installing the container stock in Year 2, the revegetation areas will have the vegetation cut using weed trimmers, which allow more selective and careful cutting. This will help to lower damage to plantings or other native plants that have naturally recruited at the site.

Migratory Birds: All weed control areas may be suitable nesting habitat for migratory birds. Weed control operations shall occur throughout the year in the planting areas and must be accomplished before weeds become suitable habitat for migratory birds (greater than 6 inches in height). The Contractor shall contact the Project Biologist if

vegetation taller than 6 inches requires removal. Work shall be conducted only after receiving approval from the Project Wildlife Biologist.

2.8 FLOOD DAMAGE AND REPAIR

In the event that channel flows cause damage within the revegetation areas, the Revegetation Contractor will be responsible for removing debris from within and between the planting basins. Basins and plant protection measures shall be repaired. If entire planting basins are destroyed or larger sections of the revegetation areas are damaged, the Project Engineer and Project Botanist may decide to not replant the areas, if they deem the areas are prone to continued damage. If portions of the revegetation areas are deleted, the deletions shall be mapped on to the As-Built for the initial plant installation, and a copy sent to the Botanical Monitor.

2.9 DEBRIS REMOVAL

The Contractor shall maintain the work site in a natural-looking condition throughout the maintenance period. Site clean-up shall occur on a daily basis for days which the Contractor has personnel onsite. All garbage, vegetative debris, excess plant material, discarded materials, and extraneous equipment shall be removed and stored or disposed of offsite in accordance with State and local regulations.

Woody debris shall not be removed from the work site unless it is a threat to public safety, promotes erosion, or may damage plantings, irrigation system components, or instream structures. The Contractor shall inform the Project Engineer if large pieces of woody debris or felled trees have moved into the revegetation areas and have damaged, or have the potential to damage, the irrigation system, plantings, and instream. The County will be responsible for removing large woody debris or felled trees from the work area if required.

2.10 MAINTENANCE ACCESS

Each revegetation area should have chipped trails or roads to allow for maintenance access for weeding, mowing and truck watering. Typically, invasive, non-native plants in the Pajaro riparian corridor can reach an average height of 8 feet by late May, and many have already set weed seed, if left uncontrolled. Maintenance access is needed to help locate the revegetation areas that are found at various intervals along the water channel.

2.11 REPORTING AND INSPECTIONS

Monthly Maintenance Log. Throughout the maintenance period, the Contractor shall keep records of maintenance activities including, but not limited to, watering schedule

and amount applied, weed control, erosion blanket/coir log repair, and replacement planting. The Contractor shall compile a record of all maintenance activities performed on a monthly maintenance log (see Appendix B Maintenance and Monitoring Forms). The Contractor shall submit a completed copy of the form to the Project Engineer within 10 days following the end of each month.

Inspections. Progress inspections and stage acceptance of the Contractor's maintenance activities will be conducted by the Project Botanist according to this Section. The Project Engineer may conduct interim inspections and bring deficiencies to the Contractor's attention at any time.

Orientation Meeting. At the beginning of the maintenance period, the Contractor shall participate in an initial orientation meeting with the Project Engineer and the County to discuss site maintenance, weed control, plant maintenance, and other maintenance activities.

Progress Inspections. The Project Botanist and the Contractor will conduct a joint inspection of the revegetation areas monthly during the irrigation season (March to October) and bimonthly during the non-irrigation season (November to February) for the duration of the maintenance period to review Contractor's work.

Final Acceptance Inspections. At the end of the maintenance period, the Project Engineer and the Contractor will inspect the work site to evaluate the acceptability of the maintenance activities. The Contractor shall provide the Project Engineer with a minimum 5-working day advance notification for the final acceptance inspection. If necessary, the Project Engineer will develop a punch list (as described below) of items to be completed by the Contractor before final acceptance. Punch list requirements shall be completed by the Contractor within 15 working days of receipt of the punch list. The Contractor shall rework, repair, and/or replant any areas determined to be unacceptable by the Project Engineer. Contractor shall be responsible for any resulting extension of the contract period and shall do so at no additional cost to the County. The unacceptable areas will be re-inspected and approved by the Project Engineer. Final acceptance of completion of the project will be granted by the Project Engineer upon satisfactory completion of the punch list items.

Punch List. Following each inspection (as described above), the Project Biologist will provide the Contractor with a punch list of items to be completed. The Contractor will have 10 working days to correct any problems identified during progress inspections. The Contractor shall rework, repair, and/or replant any areas determined to be unacceptable by the Project Engineer.

2.12 AS-BUILT DRAWINGS

Throughout the maintenance period the Contractor shall update the as-built drawings and keep written notes documenting replacement plantings, erosion control product

replacement and/or maintenance. The drawings shall also identify plants as original plants or, if required, during the maintenance period, replacement plants. A summary table describing the number and species of plants requiring replacement shall also be updated as part of the drawings. The drawings shall be updated monthly as a redlined set of construction drawings and kept on the work site available for viewing by the Project Engineer during work hours.

Within 30 days of final acceptance of the project, and prior to final payment, the Contractor shall provide final as-built drawings to the County of Santa Cruz..

2.13 MAINTENANCE ACTIVITIES YEARS 7 THROUGH 10

Maintenance in Years 7 through 10 will be conducted by the County of Santa Cruz Public Works Department maintenance staff. The amount of maintenance needed in Years 7 through 10 will be less compared to previous years. If there has been no replacement planting in Years 5 and 6, no more watering will be required. Maintenance may also include site repair and debris removal due to flood damage.

Culling and Thinning

In theory, most culling and thinning needed for plant performance will have already been done in Years 3, 4 and 5. Culling in Years 7 through 10 may be needed if the results of hydraulic analysis show that roughness should be reduced in the area.

Mowing and Weed-trimming

Mowing of the 25-foot wide buffers on the levee side of the revegetation areas and weed-trimming around the trees and shrubs planted on the 3:1 slopes will be reduced. The vegetation will be cut three times in spring and once in fall, so that herb layer does not exceed two feet in height. The spring mowing and weed trimming should be done under the direction of the Project Wildlife Biologist, so that impacts to ground nesting birds and sensitive wildlife species are minimized.

Removal of Invasive, Non-native Species

The Project Botanist will inform maintenance staff if there are locations within the revegetation areas that support high priority invasive, non-native species that need to be removed, especially Cape Ivy climbing up trees and patches of arundo (giant reed) and yellow star thistle.

CHAPTER 3.0 MONITORING AND REPORTING

The following overview describes the monitoring procedures and performance criteria that will be used to evaluate revegetation performance. Monitoring will document the success of the revegetation efforts, and will be conducted by the Project Botanist. Vegetation monitoring will include plant survival counts, vegetation sampling using belt transects, reconnaissance surveys, photodocumentation, and notes on erosion or site disturbance problems.

The results of the monitoring will be presented in the annual monitoring reports. Each year revegetation success will be assessed and remedial methods suggested and implemented. Adaptive management will be implemented, as needed to promote revegetation success and to improve habitat value of the riparian corridor.

Potential remedial actions include additional erosion control measures, seeding or container stock planting, or increased exotics removal.

3.1 MONITORING METHODS YEAR 1 THROUGH YEAR 7

Reconnaissance Surveys

The Project Botanist will survey the Revegetation Areas and their 25-foot buffers monthly during spring and summer, and every other month during fall and winter months in Years 1 through 6. The reconnaisance surveys will start the spring after bank excavation. The revegetation areas will be surveyed for invading invasive non-native plant species and weeds. The proportion of native vegetation versus non-native vegetation will be determined. The purpose of the reconnaissance surveys will be to assess how the revegetation and control of invasive non-native plants is proceeding, and to identify problems or potential problems that may exist (see monitoring form in Appendix B).

During these surveys, the monitor will look for plant damage, pests and diseases, and will make recommendations to correct any significant problems or potential problems. Plants are most vulnerable to many types of distrubances during the early part of the establishment period, so monitoring must be relatively intense during these early years. These visits will also be used to document the need to change or adjust revegetation plan activities (i.e., altering the maintenance schedule, adding extra weed control visits, increasing or reducing the frequency or amount of watering, etc.).

Monitoring of Natural Recruitment of Native Plant Species

The revegetation areas and their 25-foot buffers will be monitored in spring and summer in Years 1 through 4 to see which native plant species re-establish naturally. The Project Botanist shall conduct the monitoring of natural recruitment.

Notes recorded on naturally recruiting native species will guide the active revegetation of the excavation sites. The proposed planting lists in this Plan (see Appendix A) are therefore subject to refinement according to the monitoring results. It is expected that willow species and water-loving plants such as rushes, tules and sedges will establish naturally along the excavated benches. Such recruitment will be quantified, and credit given, so that fewer short cuttings and plant divisions will need to be planted. A 1:1 ratio will apply. For example, if one California tule volunteers on the bench, then one less division of California tule will need to be planted. Such changes will be noted on the As-built drawings

Vegetation Sampling (Belt Transects)

The Project Botanist will conduct vegetation sampling in Years 3, 4, 5 and 6. The belt transects will be 10 feet wide (along the riverbank) with the long side (varies approximately 15 feet) perpendicular to the river such that the long side spans the length of the newly excavated bench and 3:1 bank . The Project Botanist will establish the transect locations the first spring after the initial planting of container stock. Belt transects will be established in each of the 11 revegetation areas such that a minimum of 1.0% of the new bench and 3:1 bank areas are sampled. Some of the belt transect locations will coincide with the location of cross sections established by Northwest Hydraulic Consultants to study hydraulic impacts and roughness. The number and location of belt transects will be determined the first spring after the initial planting of container stock. The locations of the transects will be mapped on an aerial map provided by the County of Santa Cruz, and the belt transect corners will be marked in the field. In subsequent monitoring years, these same location will be re-monitored. For each belt transect, the percent vegetative cover according to species should be determined through visual estimation. In addition, the percent bare ground, percent mulch/organic litter, and percent artificial bank stabilization (i.e., rip rap, cement, etc.) should be recorded. If open water is detected, its percentage will also be recorded.

The data collected from the transects will provide information on native vegetative cover, cover of invasive non-native species, and the average height of the woody species planted to see if the revegetation areas are on track with meeting the performance criteria presented in this chapter (see monitoring form in Appendix B).

Detailed Monitoring of Plant Survival, Vigor, and Growth

The Project Botanist will conduct survival and vigor assessments in Years 3, 4, 5 and 6. In addition to the reconnaissance surveys and vegetation sampling, one additional monitoring visit will be made in summer for four years following the installation of container stock. The summer monitoring will verify plant vigor, plant survival, and whether the performance criteria are being met. The number of living and number of dead plantings will be recorded according to species in each revegetation area. The height of planted trees and shrubs from container stock will be measured to the nearest

third of a foot. The width/spread of the trees and shrub plantings will be visually estimated (see monitoring form in Appendix B).

Each tree and shrub container stock planting within a restoration area will also be evaluated for vigor by using the following vigor rating system.

Vigor Rating System

0 = Dead
1 = Poor, greater than 75% of plant affected by cumulative symptoms
2 = Fair, 25 to 75% of plant affected by cumulative symptoms
3 = Good, less than 25% of plant affected by cumulative symptoms
4 = Excellent, less the 5% of plant affected by cumulative symptoms

Factors evaluated to determine the vigor ratings include presence of pests and diseases, mechanical damage, bud development, new growth, foliage color, herbivore and drought stress.

Photodocumentation

During the spring monitoring, the Project Botanist will take photographs to document the condition of each revegetation area. Photographs will be taken from the same vantage point (photostation) and in the same direction every year. Belt transects that coincide with the crossection locations used for hydraulic analysis will also be photographed. Selected photographs will be included in the annual reports. The locations of the photostations shall be mapped onto a current aerial photograph the year of the initial planting to facilitate repeat photographs fron the same position in subsequent years.

3.2 PERFORMANCE CRITERIA YEAR 1 THROUGH YEAR 6

Attributes to be monitored include: natural recruitment, plant survival, plant vigor, vegetative cover, soil erosion, and the proportion of invasive, non-native plant species. The specific performance criteria follow:

Plant Survival Criteria for Container Stock

First Fall after Planting: The target survival rate for all plants in a revegetation area is 100%. If monitoring results determine that percent survival is less than 100%, all of the dead and dying plantings shall be replaced by the Revegetation Contractor.

Second Fall after Planting: The target survival rate for all plants in a revegetation area is 90%. If monitoring results determine that the percent survival is less than 90%, the minimum number of plants required to achieve the 90% survival criterion shall be replaced by the Revegetation Contractor.

Third Fall after Planting: The target survival rate for all plants in a revegetation area is 80%. If percent survival is less than 80%, the minimum number of plants required to achieve the 80% survival criterion shall be replaced by the Revegetation Contractor.

Plant Survival of Willow Cuttings, Cottonwood Cuttings and Plant Divisions

Seventy percent (70%) survival of willow and black cottonwood short cuttings, and 70% survival of transplanted divisions of wetland species such as bulrush, tall cyperus and bur reed during Years 1 through 3 of the establishment period.

Plant Vigor

The majority of the tree and shrub plantings should have fair to good vigor.

Vegetative Cover of Invasive, Non-native Plant Species

Maximum of 5% vegetative cover within the revegetation areas of high priority/perennial, invasive, non-native plants, including Cape ivy, giant reed, jubata/pampas grass, French broom, yellow star thistle, and poison hemlock. For additional high priority invasive plants for removal, see Table 1.

Trend of Increasing Woody Cover of Native Species Year 2 through Year 6

Minimum annual increase of 4% for average native tree cover (all species combined) and minimum annual increase of 4% for average native shrub cover (all species ccombined).

Bare Ground. Maximum of 10% bare ground.

3.3 MONITORING METHODS YEARS 7 THROUGH 10

Monitoring methods will be reduced in scope during Years 7 through 10. Reconnaissance surveys of the revegetation areas will be reduced to four surveys during spring and summer. Plant survival counts and vigor assessments will no longer be conducted. Photodocumentation and vegetation sampling will continue.

Vegetation Sampling

Vegetation sampling using belt transects will be conducted in Year 8 and Year 10 as described above, since the transects provide data on vegetative cover, proportion of native versus non-native vegetation and average height of trees and shrubs. This information is needed to document trends in vegetative cover, and also provides data for hydraulic analysis of channel roughness. The monitoring results collected from the belt transects will be summarized in the annual monitoring reports to determine whether the revegetation areas are still meeting the established performance standards.

Photodocumentation

As described for Years 1 through 6, spring photographs will be taken to document the conditions of each revegetation area. Photographs will be taken from the same vantage point (photostation) and in the same direction every year. Belt transects that coincide with the crossection locations used for hydraulic analysis will also be photographed. Selected photographs will be included in the annual reports.

3.4 PERFORMANCE CRITERIA YEAR 7 THROUGH YEAR 10

The final success criteria for vegetative cover will be applied separately to each of the 11 riparian revegetation areas. Percent cover is positively correlated with aboveground plant biomass and wildlife use and will be used as the primary indicator of successful establishment of riparian habitat. The final success criteria for average percent cover shall be met by 10 years following the hydroseeding in Year 1.

Percent Woody Cover

Average percent cover of native woody species in the revegetation areas is expected to be relatively low during the first three years following plant installation, but should increase quickly thereafter. The table below provides target performance criteria for percent cover for Year 7 through Year 10 of the maintenance and monitoring period.

Year 10 Criteria. For areas interplanted with trees and shrubs, average percent cover by Year 10 shall be 40% by native trees and 20% by native shrubs. If tree cover exceeds the final goal, the final success criteria for shrub cover may be reduced by a corresponding amount.

Performance Criteria for Tree and Shrub Cover Years 8 through Year 10

Monitoring Year	Average Percent Cover of Native Trees	Average Percent Cover of Native Shrubs
Year 8	30%	15%
Year 9	35%	18%
Year 10	40%	20%

Tree Height

Tree height is a useful measure of the vigor and value of riparian habitat. The table below provides goals for tree height for selected species in Year 5 and Year 10.

Performance Criteria for Tree Heights

Species	Year 5 Average Height (feet)	Year 10 Average Height (feet)
Arroyo Willow	6	12
Box Elder	5	10
Coast Live Oak	5	10
Blue Elderberry	6	12
Red Willow	6	12
Red or White Alder	6	12

3.5 REPORT PREPARATION

Annual Reports

During the ten-year maintenance and monitoring period, annual monitoring reports will be prepared in January that document the results of the reconnaissance surveys, summer monitoring, maintenance and revegetation activities. The annual report for the restoration program should document the findings of the year's monitoring, highlight problems and successes, date of monitoring, who performed the monitoring, yearly photographs, and other appropriate information. The reports will recommend remedial actions to be undertaken if the revegetation is not meeting the above period performance criteria. Reports shall be submitted to the USFWS, CORPS, County of Santa Cruz, RWQCB and CDFG.

Final Report

A Final Report will be prepared in January of Year 11 that presents the last revegetation area monitoring results. The Final Report will make recommendations for the future management of the revegetation areas and address any adaptive management needs. The report will be submitted to the USFWS, CORPS, County of Santa Cruz, RWQCB and CDFG.

3.6 ADAPTIVE MANAGEMENT

The proposed revegetation project has provisions for adaptive management. Adaptive management provides for flexible management practices that may be modified according to monitoring results and site performance. Some flexibility is necessary in response to changes in site conditions such as flood damage , drought, etc. As the proposed revegetation activities are implemented and monitored for success, refinements to the

revegetation and maintenance methods are expected. The monitoring results for natural recruitment will have a key part in the adaptive management of the revegetation areas.

Natural Recruitment

Monitoring for native species that naturally recruit or establish in a revegetation area may be taken into account when determining the number of plants to install. Natural recruitment on the newly excavated benches and riverbanks is expected, especially willows and water-loving plants along the channel edge. As part of the monitoring surveys, the number of recruits will be evaluated, and credit given at a 1:1 ratio. For example, if sedges, rushes, and bulrushes come in naturally, then the number of divisions proposed for planting of these species may be reduced by one per one recruit. Similarly, if some of the willow cuttings die, naturally recruiting willows may provide credit, so that less replanting is necessary.

Field Fitting

There is also some flexibility in selecting the locations for planting. The planting lists for each revegetation area provide bank or channel locations for each species that are meant to guide the installation. Field fitting with the assistance of the Biological Monitors is encouraged, so that the plants are installed in the best locations for successful establishment.

Weather and Rainfall

Weather patterns and rainfall will also need to be considered, and the amount of supplemental watering adjusted accordingly.

Flood Damage

Sections of some revegetation areas may need to be abandoned if there is significant flood damage. Any reduction in the size/area of a revegetation area will be agreed upon and documented b the Project Engineer, Revegetation Contractor, and Biological Monitor.

Maintenance and Monitoring Period

If there has been a lot of remedial planting, especially native tree species, and/or Performance Criteria have not been met, the length of the maintenance and monitoring may be extended one to two years.

REFERENCES AND LITERATURE CITED

California Native Plant Society (CNPS), CNPS Electronic Inventory data request for U.S. Geological Survey 7.5-minute topographic quadrangles: Soquel, Watsonville West, Watsonville East, Moss Landing, and Prunedale, information accessed July 15, 2011.

California Native Plant Society. September 1996. Policy on Invasive Non-native Plants in California, Sacramento, California.

CH_2M Hill. 1997. Phase II Report: Pajaro River Management & Restoration Plan. Prepared in partnership with Northwest Hydraulic Consultants, Inc. and Greening Associates. Prepared for Santa Cruz County Flood Control and Water Conservation District, Zone 7.

County of Santa Cruz. October 1994. County of Santa Cruz General Plan and Local Coastal Plan – 1990 –2005 Environmental Quality Element, Santa Cruz, California.

Hoag, J.C. 1993b. How to Plant Willows and Cottonwoods for Riparian Rehabilitation. USDA Natural Resources Conservation Service, Idaho Plant Materials Technical Note #23, Boise, ID.

Hoag, J.C., G. L.. Young, and J. L. Gibbs. 1991. Planting Techniques for Vegetating Riparian Areas from the Aberdeen Plant Materials Center Paper presented at the 45th Annual Meeting of the Society of Range Management, Spokane, WA.

Fuller, T.C. and G.D. Barbe. 1985. The Bradley Method of Eliminating Exotic Plants from Natural Reserves. *Fremontia*, July 1985.

Guinon, M. 1992. Promoting Gene Conservation through Seed and Plant Procurement. *In:* Proceedings, Western Forest Nursery Association, held September 1992, Fallen Leaf Lake, CA.

The Jepson Manual of Vascular Plants of California 2nd Edition, in Press 2011. University of California Press, Berkeley, CA.

Kittleson, G. 2006. Final Preliminary Biotic Impact and Mitigation Assessment –Proposed Pajaro River Levee Bench Sediment Excavation Project.

Kittleson, G. and V. Haley. 2004. Riparian Habitat Acreage Impacted by Pajaro River Vegetation Thinning Activities, Santa Cruz County Department of Public Works.

Northwest Hydraulic Consultants, Inc. 2011a. Pajaro River Bench Excavation Project 65% Revised Basis of Design Memorandum. Prepared for Santa Cruz County Flood Control and Water Conservation District, Zone 7.

Northwest Hydraulic Consultants, Inc. 2011b. Pajaro River Bench Excavation Project 75% Basis of Design Memorandum. Prepared for Santa Cruz County Flood Control and Water Conservation District, Zone 7.

Salix Applied Earthcare. 1999. Biotechnical Erosion Control for Slopes and Streambanks Manual. John McCullah. Workshop April 8, 1999, Zayante Fire Department, Felton, CA..

Shields, F.D. and D.H. Gray. 1993. Effects of Woody Vegetation on the Structural Intergrity of Sandy Levees. Water Resources Bulletin 28(5): 917-931.

Singer, S.W. 1992. Groundcover – A Planting Guide for Erosion Control and Site Improvement on the Central Coast (San Francisco to Big Sur). Santa Cruz County Resource Conservation District, Aptos, CA.

Thomas, John Hunter. 1961. Flora of the Santa Cruz Mountains of California. A Manual of the Vascular Plants. Stanford University Press, Stanford, CA.

Personal Communications

Northwest Hydraulic Consultants, personal communication, January 17, 2012.