



LIVE OAK ASSOCIATES, INC.

an Ecological Consulting Firm

CINNABAR HILLS GOLF CLUB

YEARS 1-10 RIPARIAN MONITORING REPORT

Prepared by

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EXECUTIVE SUMMARY

In October 2010, Live Oak Associates, Inc., conducted Years 1-10 (depending on the site) riparian mitigation monitoring in the combination and riparian sites at Cinnabar Hills Golf Club. These surveys were conducted in accordance with the *Tradition Golf Club, Mitigation and Monitoring Plan* (H. T. Harvey and Associates 1996), which establishes a mitigation goal of 9.60 acres of onsite riparian habitat to be created. The purpose of the surveys was to determine if the combination and riparian mitigation areas have met their annual performance criteria. The riparian and combination mitigation areas were surveyed for survivorship and percent cover of native trees and shrubs from the previous years of plantings. Natural reproduction/recruitment and plant vigor/health were also recorded for the planted woody species. Tree height and basal area were collected for three percent of each tree species installed, which were randomly chosen.

Plant survival was monitored in one site, which met the 80% survival performance criterion. Replanting will not be required at this site. Relative percent cover by native trees, native shrubs, and valley oaks was monitored for all fourteen sites. Approximately half of the sites met the native tree and shrub cover benchmark criteria, while one site met the valley oak benchmark criterion. Natural reproduction/recruitment continued during this year's monitoring, particularly with the oak tree and shrub species. Tree height and basal area were monitored for all fourteen sites (i.e., sites in at least their third year of monitoring). Forty-six of the 75 trees sampled met the required tree height for the site's respective monitoring year. Nine of the fourteen sites being monitored for basal area met the required criterion. Plant vigor and health of the surviving shrubs and trees was also monitored. Overall, 93% of these species were considered to have good vigor and health. During the 2010 monitoring, it was estimated that 10.17 acres of created riparian habitat were present.

Two sites are in their tenth and final year of monitoring. While not all of the final performance criteria were reached, plant survivorship for both sites remained at over 80% in those years where survivorship data was recorded, overall plant health and vigor has been good to fair, and percent native tree and shrub cover for both of these sites have remained consistent over the years. All of these characters indicate that these sites are self-sustaining and have reached an ecological equilibrium that is adapted to the environmental conditions of their particular location.

TABLE OF CONTENTS

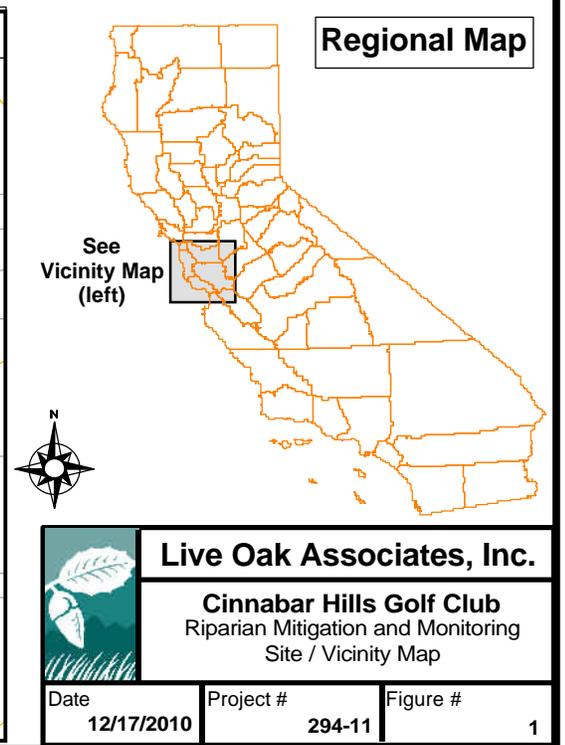
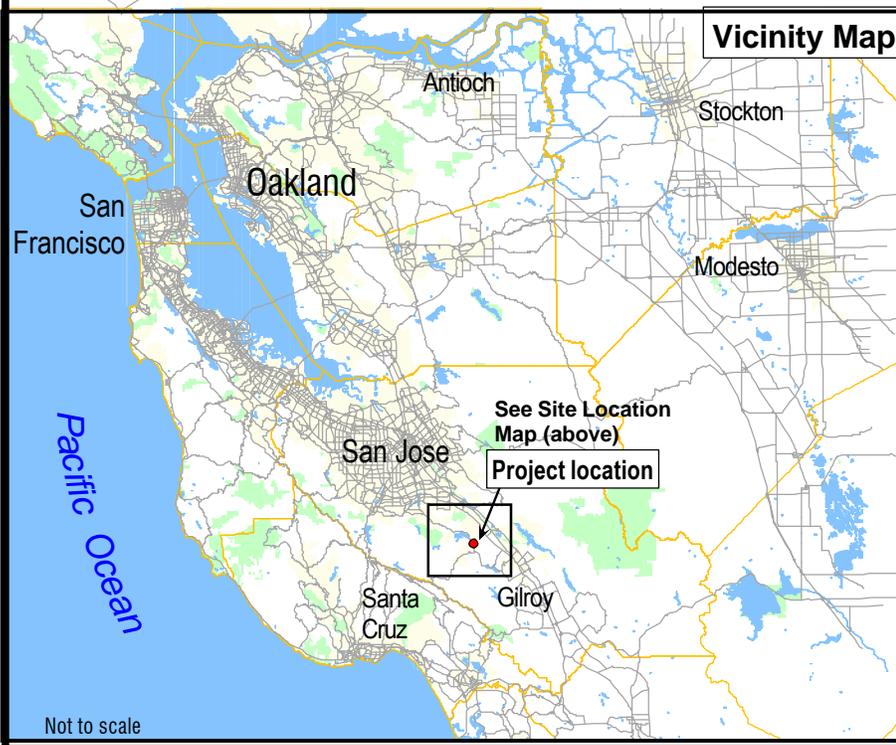
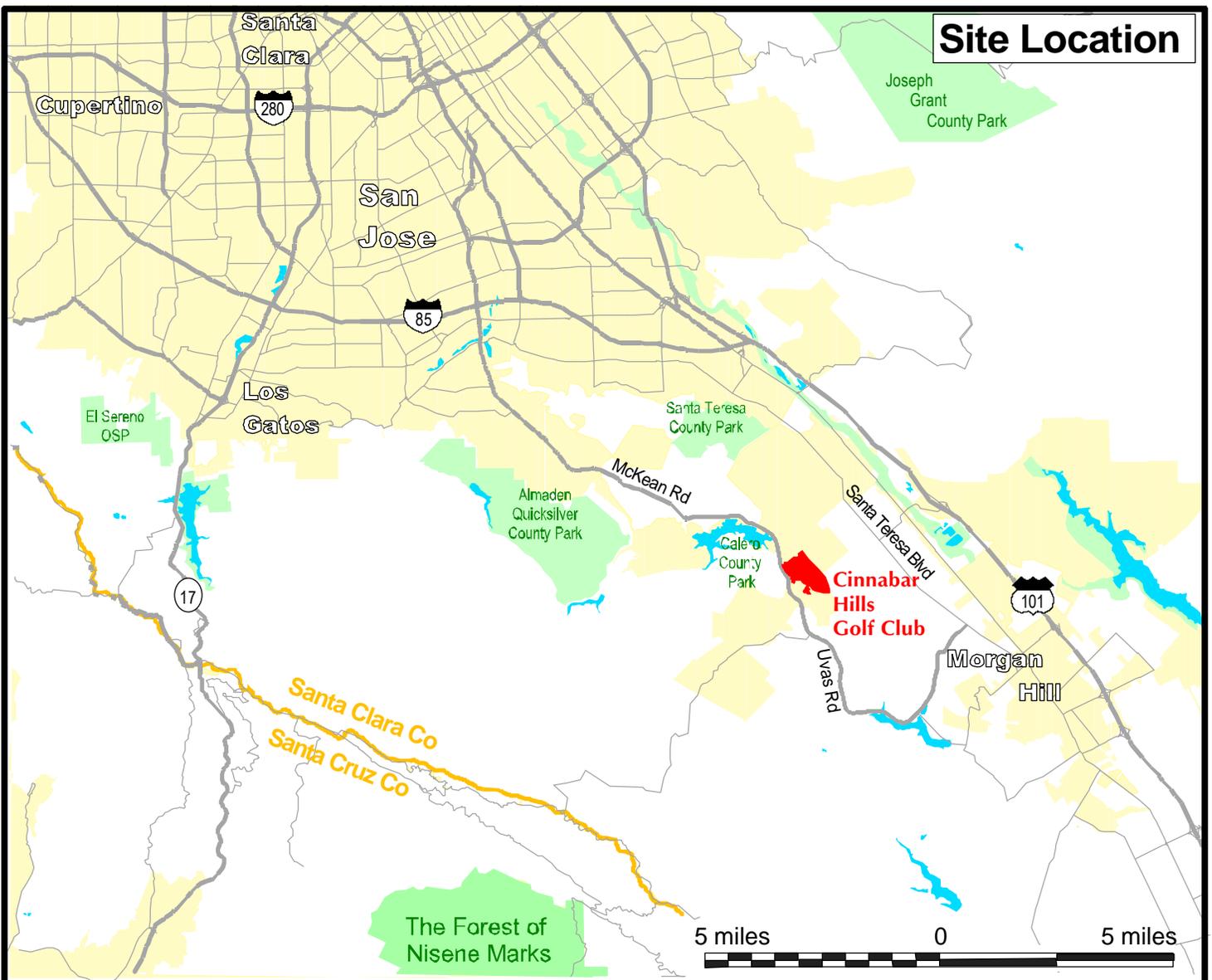
EXECUTIVE SUMMARY	I
TABLE OF CONTENTS.....	II
1.0 INTRODUCTION	1
2.0 RECAPITULATION OF THE MITIGATION AND MONITORING PLAN	5
2.1 FINAL SUCCESS CRITERIA.....	5
2.2 PERFORMANCE CRITERIA	6
2.2.1 Plant Survival.....	6
2.2.2 Percent Cover, Basal Area, and Tree Height	7
2.2.3 Site Maintenance.....	8
3.0 METHODS FOR MITIGATION MONITORING.....	9
3.1 PERCENT COVER	9
3.2 PLANT SURVIVAL	10
3.3 NATURAL REPRODUCTION/RECRUITMENT	10
3.4 TREE HEIGHT.....	11
3.5 BASAL AREA.....	11
3.6 PLANT VIGOR AND HEALTH	11
3.7 DETERMINING TOTAL ACREAGE OF RIPARIAN MITIGATION SITES	12
3.8 SITE MAINTENANCE.....	12
3.9 PHOTO DOCUMENTATION	12
4.0 RESULTS OF MITIGATION MONITORING	13
4.1 PERCENT COVER	13
4.2 PLANT SURVIVAL	13
4.3 NATURAL REPRODUCTION/RECRUITMENT	14
4.4 TREE HEIGHT AND BASAL AREA	15
4.5 PLANT VIGOR AND HEALTH	17
4.6 TOTAL AREA OF CONSTRUCTED COMBINATION AND RIPARIAN MITIGATION SITES.....	18
4.7 SITE MAINTENANCE.....	19
5.0 DISCUSSION.....	20
5.1 ALL SITES.....	20
5.2 YEAR 10 SITES	21
6.0 RECOMMENDATIONS.....	22
6.1 ADDITIONAL PLANTINGS	22
6.2 SITE MAINTENANCE.....	22
6.3 MONITORING IN 2011.....	23
LITERATURE CITED	25
APPENDIX A: VASCULAR PLANTS OF THE STUDY AREA	27
APPENDIX B: PHOTODOCUMENTATION OF THE MITIGATION SITES IN 2010.....	31

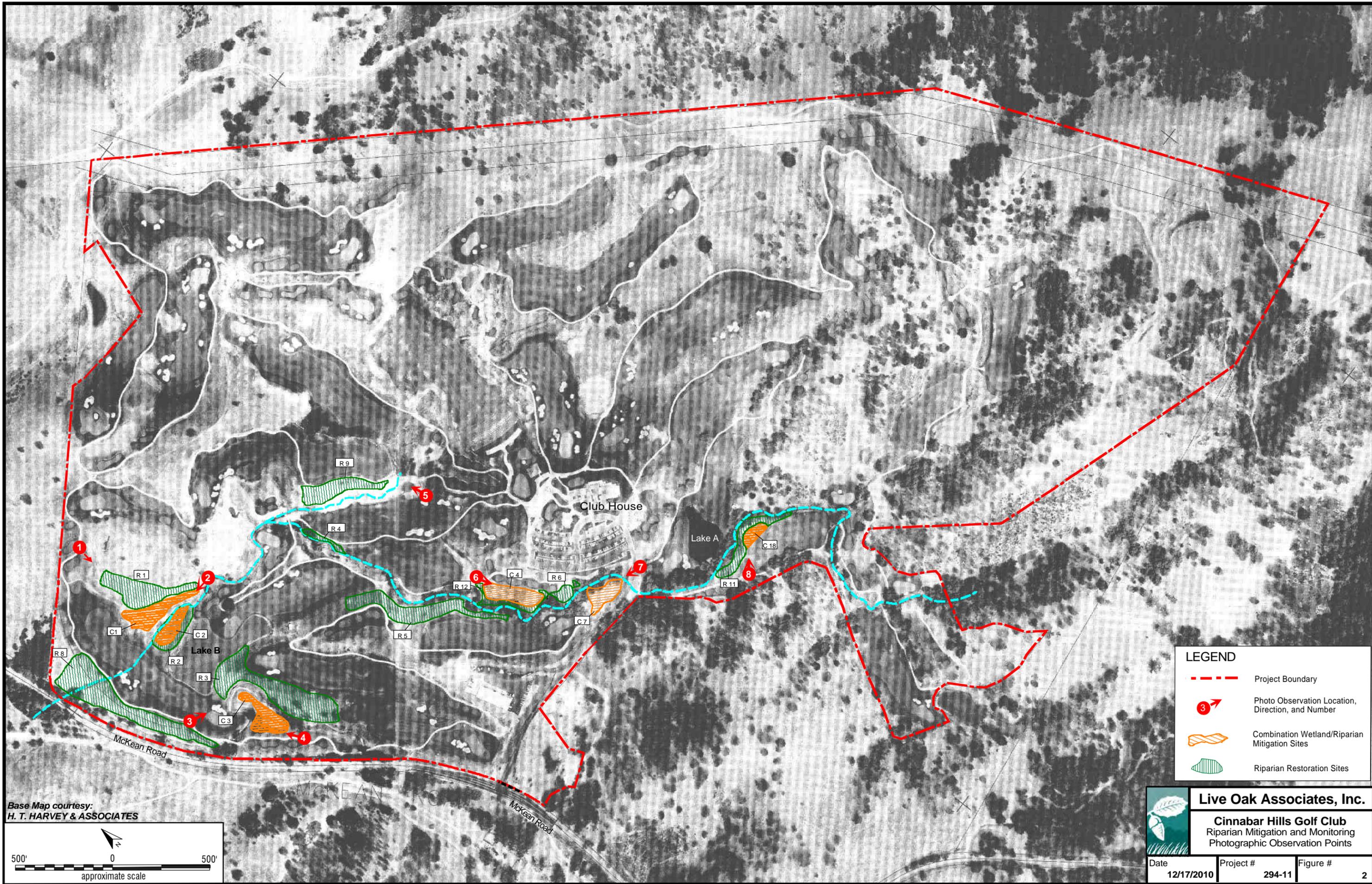
1.0 INTRODUCTION

Cinnabar Hills Golf Club is a 347-acre site located southeast of Calero Reservoir in southern San Jose, Santa Clara County, California (Fig. 1). The golf club is bordered by McKean Road and Calero County Park to the west, Calero County Park and Santa Clara Valley Water District (SCVWD) property to the north, and undeveloped lands to the east and south. Elevations range from approximately 320 ft. National Geodetic Vertical Datum (NGVD) to 780 ft. NGVD. Five soil-mapping units have been identified on the site; these include Gaviota gravelly loam, 30 to 75 percent slopes; Hillgate silt loam, 2 to 9 percent slopes; Positas-Saratoga loams, 2 to 9 percent slopes; Vallecitos loam, 15 to 30 percent slopes; and Vallecitos loam, 50 to 75 percent slopes (NRCS 1958). These five units are not considered to be hydric, but hydric inclusions may occur where drainage is poor.

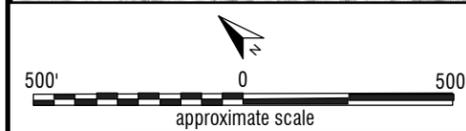
Cinnabar Hills Golf Club, in compliance with the requirements outlined in the *Tradition Golf Club, Mitigation and Monitoring Plan* (H. T. Harvey and Associates 1996), was required to create 9.60 acres of new riparian habitat within the project area. Mitigation sites consisted of either combination (wetland/riparian) areas or riparian areas. Combination areas were created by excavating streambanks in lower channel areas of the site. These combination areas were created in 1999, while the riparian vegetation was planted between 2000 and 2009. Riparian areas that had been destroyed due to years of agricultural uses were required to be restored and existing riparian habitat expanded to make up for the loss of riparian habitat; these areas were planted between 2001 and 2009. The final success criterion for the replacement riparian habitats is that 9.60 acres meet the criteria set by the *Mitigation and Monitoring Plan* within ten years following installation.

Live Oak Associates, Inc. (LOA), surveyed the Cinnabar Hills Golf Club combination (i.e., wetland and riparian) mitigation areas and riparian mitigation areas on October 11, 14, 15, and 19, 2010 (Fig. 2). Depending on the site, Years 1-10 riparian mitigation monitoring was completed in order to determine if the mitigation areas met the established criteria for their respective monitoring year (Table 1). **Sites C1 and C4 are in their tenth and final year of monitoring.**





Base Map courtesy:
H. T. HARVEY & ASSOCIATES



LEGEND

-  Project Boundary
-  Photo Observation Location, Direction, and Number
-  Combination Wetland/Riparian Mitigation Sites
-  Riparian Restoration Sites

Live Oak Associates, Inc.

Cinnabar Hills Golf Club
Riparian Mitigation and Monitoring
Photographic Observation Points

Date	Project #	Figure #
12/17/2010	294-11	2

Table 1. Riparian monitoring criteria to be used in 2010 for the riparian and combination sites.

Monitoring Year	Riparian Site	Reason
Year 5	R8	Percent survival greater than 60%
Year 6	C3	Percent survival greater than 60%
Year 7	C7	Percent survival greater than 60%
Year 8	R6	Percent survival greater than 60%
	R9	Percent survival greater than 60%
	C18, R11	Percent survival greater than 60%
	R12	Percent survival greater than 60%
Year 9	R1	Percent survival greater than 60%
	R2, C2	Percent survival greater than 60%
	R3	Percent survival greater than 60%
	R4	Percent survival greater than 60%
	R5	Percent survival greater than 60%
Year 10	C1	Percent survival greater than 60%
	C4	Percent survival greater than 60%

2.0 RECAPITULATION OF THE MITIGATION AND MONITORING PLAN

The following is a précis of the mitigation and monitoring goals for the Cinnabar Hills Golf Course as documented in the *Tradition Golf Club, Mitigation and Monitoring Plan* (1996) and *Cinnabar Hills Golf Club As-Built Plan for Wetland Mitigation Sites* (2000), both prepared by H.T. Harvey and Associates. According to the plans, the riparian mitigation sites, including combination areas, will be monitored over a minimum of 10 years, annually in Years 1-6, and once in Years 8 and 10. By Year 10, the riparian mitigation sites should be sufficiently well-established to determine if they will reach their long-term goals with little chance of failure. The results of the monitoring in Year 10 will be compared to the final success criteria to determine if these criteria have been met. If the final success criteria have not been met at the end of the respective monitoring periods, monitoring will continue until they have been met.

2.1 FINAL SUCCESS CRITERIA

The final success criteria will be evaluated in the last year of the monitoring periods. The final riparian target functions and values include the following:

- **Percent Cover.** Percent cover will be used as a primary indicator of successful establishment of riparian habitat. The final percent cover goal is 50% native tree cover and 20% native shrub cover for the floodplain and slope associations and 35% native tree cover for the valley oak.
- **Basal Area.** Basal area provides a good measure of riparian forest biomass and tree diameter growth. The basal area goal is 15 ft.²/acre and shall be applied equally to all plant associations.
- **Tree Height.** Final tree height goals vary between species and reflect their different growth patterns (Table 2).

Table 2. Cinnabar Hills Golf Course tree height final goals.

Common Name	Scientific Name	Height (ft.)
California sycamore	<i>Platanus racemosa</i>	20
Mexican elderberry	<i>Sambucus mexicana</i>	10
California bay	<i>Umbellularia californica</i>	8
California buckeye	<i>Aesculus californica</i>	10
Coast live oak	<i>Quercus agrifolia</i>	12
Red willow	<i>Salix laevigata</i>	20
Valley oak	<i>Quercus lobata</i>	12

2.2 PERFORMANCE CRITERIA

The performance criteria (i.e., survival, percent cover, basal area, tree height, and site maintenance) are quantitative benchmarks against which revegetation progress can be tracked. Trend characteristics, such as plant vigor, plant health, and natural reproduction, are site characteristics to be monitored over time, but these have no fixed criteria. Monitoring of the trend characteristics will provide valuable supplementary information concerning site development and help guide maintenance activities and remedial action, if required.

2.2.1 Plant Survival

All trees and shrubs installed have an 80% survival performance criterion during the three-year plant establishment period. All dead plants will be replaced if survival falls below this performance criterion. In Year 5, two years after the completion of plant establishment and the cessation of artificial irrigation, survival shall not be lower than 60%. All dead plants will be replaced if survival falls below the Year 5 performance criterion. The monitoring period shall start anew following replanting at any time in Years 1-5, if survival falls below 60%. Survival results following the cessation of irrigation will indicate whether plants' roots are sufficiently developed to support the plants under natural conditions.

2.2.2 Percent Cover, Basal Area, and Tree Height

While the ultimate goal is to meet the final performance criteria, annual quantitative benchmarks have been set for percent cover (Tables 3 and 4), tree height (Table 5), and basal area (Table 6).

Table 3. Cinnabar Hills Golf Course floodplain and slope association percent cover performance criteria.

Monitoring Year	Tree cover	Shrub Cover
Year 2	2%	1%
Year 3	4%	3%
Year 4	8%	5%
Year 5	15%	7%
Year 6	25%	10%
Year 8	35%	15%

Table 4. Cinnabar Hills Golf Course valley oak association percent cover performance criteria.

Monitoring Year	Tree cover
Year 2	2%
Year 3	4%
Year 4	8%
Year 5	15%
Year 6	25%
Year 8	35%

Table 5. Cinnabar Hills Golf Course monitoring tree height performance criteria.

Species	Year 2 (ft.)	Year 3 (ft.)	Year 4 (ft.)	Year 5 (ft.)	Year 6 (ft.)	Year 8 (ft.)
California sycamore	3	5	8	11	14	17
Mexican elderberry	3	4	5	6	7	9
California bay	3	5	8	11	14	17
California buckeye	2	3	4	5	6	7
Coast live oak	3	4	5	6	7	9
Red willow	2	3	4	5	7	9
Valley oak	2	3	4	5	7	9

Table 6. Cinnabar Hills Golf Course monitoring basal area performance criteria.

Year	Year 3	Year 4	Year 5	Year 6	Year 8
Square feet per acre	0.25	1	3	7	11

2.2.3 Site Maintenance

Site maintenance is included in the performance criteria because of the critical importance of proper procedures during the plant establishment period. Site maintenance monitoring will assess plant replacement, weed control, irrigation system maintenance, and foliage protector maintenance. Site maintenance will be monitored during the three-year plant establishment period.

3.0 METHODS FOR MITIGATION MONITORING

The following methods were designed according to the *Tradition Golf Club, Mitigation and Monitoring Plan* (H.T. Harvey and Associates 1996), *Cinnabar Hills Golf Club As-Built Plan for Wetland Mitigation Sites* (H.T. Harvey and Associates 2000), and previous monitoring reports (Live Oak Associates, Inc. 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009).

3.1 PERCENT COVER

Per the *Tradition Golf Club, Mitigation and Monitoring Plan* (1996), the relative percent cover of native trees and shrubs in each mitigation site was calculated for all sites.

At least one random point was established for each riparian and combination mitigation site. The number of random points established for each mitigation site was based on area; for each site, one random point was selected for each 0.30 acres (Table 7). Each randomly-selected point was permanently marked with rebar for replication in subsequent monitoring years. For each randomly-selected point, a 40-ft. transect line was run in a randomly-chosen direction. The direction of the line was recorded so that the transect would be run in this same direction in all subsequent monitoring years.

Relative percent cover of native trees and native shrubs was measured utilizing the line-intercept method along each 40-ft. transect. For all transects beginning at the 2-ft. mark, all plant species underlying or overhanging the line at each 2-ft. point were recorded on a data sheet and tallied.

Percent cover by native trees and native shrubs along each transect was calculated by dividing the total of the tallied hits by native trees and native shrubs by the total number of tallied hits for all plant species. The average relative percent cover over all transects for each riparian and combination site was then calculated.

Two pairs of adjacent sites—sites C2 and R2 and sites C18 and R11—were sampled together because their individual boundaries had become less distinctive as the sites have matured. Therefore, in 2009, percent cover was measured at fourteen sites.

Table 7. Number of random transects for each mitigation site.

Site	Number of Transects
R1	3
R2/C2	2
R3	7
R4	1
R5	4
R6	1
R8	7
R9	3
R11/C18	3
R12	1
C1	2
C3	2
C4	2
C7	2

3.2 PLANT SURVIVAL

The survivorship of plantings was determined by field counts of all trees and shrubs by species planted in the mitigation sites. This was modified from the *Tradition Golf Club, Mitigation and Monitoring Plan* (H.T. Harvey and Associates 1996) requiring a minimum of 10% of all trees and shrubs planted to be randomly selected. Plant survival will be conducted for Years 1-5 of monitoring of each site or until such time that the growth of the plants makes survivorship too difficult to accurately assess. At that time, percent cover measurements will become the primary indicator of plant establishment rates.

In 2010, only one site (R8) was within the initial five-year plant establishment period. Therefore, only this site was monitored for plant survival.

3.3 NATURAL REPRODUCTION/RECRUITMENT

Natural reproduction and recruitment of woody plant species within the four combination sites and ten riparian sites were monitored in 2010 while surveying for percent cover and plant survival. Additional trees or shrubs of species that had been previously planted were counted and considered to be natural reproduction and recruitment. Any other native and non-native woody plants that became established were counted and reported by species. This was modified from the *Tradition Golf Club, Mitigation and Monitoring Plan* (H.T. Harvey and Associates

1996) requiring that natural reproduction and recruitment of woody plant species were to be monitored in a five-foot wide band along each transect.

3.4 TREE HEIGHT

At a minimum, three percent of each tree species installed were sampled in each site. Selection of the individuals to be monitored was semi-random, with individuals from all parts of each site selected. In order for the trees to be monitored in subsequent years, each tree selected for height monitoring was marked with flagging tape and an aluminum tag labeled with the mitigation site number, plant number being tagged at that site, date, and tree species. A total of 76 trees were surveyed in the four combination areas and ten riparian areas in 2010. Results were reported by species.

3.5 BASAL AREA

All trees sampled for height were also sampled for basal area. Basal area was measured utilizing the diameter at breast height (DBH) or at 4.5 feet, with the exception of the trees that fell below this height. The square feet of basal area per acre for each mitigation site was calculated based on the size of the mitigation site and percentage of trees within the site that were sampled beginning in Year 3 (Table 6). The following formula was used:

$$\text{Basal area per acre (ft.}^2\text{/acre)} = \text{Sum of basal areas (ft.}^2\text{)} * \frac{\text{\# of trees observed}}{\text{\# of trees sampled}} * \frac{1}{\text{Area of mitigation site (acres)}}$$

3.6 PLANT VIGOR AND HEALTH

At each riparian and combination mitigation site, the overall plant vigor and health of the installed trees and shrubs were monitored. Factors taken into consideration in the qualitative observation of vigor and health include plant color, bud development, new growth, herbivory, drought stress, fungal/insect infestation, and physical damage. Overall health and vigor was rated according to the following scale:

High = 1-3 = 67-100% healthy foliage

Medium = 4-6 = 34-66% healthy foliage

Low = 7-9 = 0-33% healthy foliage

Dead = 10

If a plant's foliage was abnormally sparse, then the health/vigor rating was lowered accordingly, even if the foliage present was healthy.

3.7 DETERMINING TOTAL ACREAGE OF RIPARIAN MITIGATION SITES

The total acreage of combination and riparian areas created was determined using a GPS unit to ascertain if the required acreage of constructed mitigation sites were met. The total area that needs to be constructed for riparian areas as required by the CDFG is 9.60 acres.

3.8 SITE MAINTENANCE

Site maintenance was assessed during quarterly site monitoring visits. The golf course maintenance supervisor was contacted if sites appeared to be inadequately maintained and for updates on what maintenance measures had occurred during the monitoring year.

3.9 PHOTO DOCUMENTATION

Photos were taken from vantage points that most clearly depicted conditions in the various mitigation sites. All photo points were taken in the same location and direction as in previous monitoring years (Appendix B).

4.0 RESULTS OF MITIGATION MONITORING

4.1 PERCENT COVER

Specific annual benchmark performance criteria have been established for percent cover of native trees and shrubs and for percent cover of valley oak. All fourteen mitigation areas were monitored according to when they were planted and whether or not they met the performance criteria for previous monitoring years. Six of the sites, or approximately 43% of the sites, met the native tree cover criterion, while eight sites, or approximately 57% of the sites, met the native shrub cover criterion. Two of four Year 8 sites (i.e., C18/R11 and R12) and two of five Year 9 sites (i.e., R2/C2 and R4) met the benchmark for native tree cover (shown in bold and italics in Table 8). One Year 8 site (i.e., R9) and three Year 9 sites (i.e., R2/C2, R3, and R4) met the benchmark for native shrub cover. Only one site, R4, met the benchmark for all three criteria; shrub cover and valley oak cover also met the final performance criteria.

For C1, one of the two sites in the tenth and final year of monitoring, the site did not meet any of the three final criteria. The other Year 10 site, C4, only met the final performance criteria for native shrub cover. However, for both sites, all percent cover results were relatively unchanged from the 2009 results.

R4 was the only site to meet the valley oak association performance benchmark for its respective monitoring year.

4.2 PLANT SURVIVAL

The total number of planted trees and shrubs were counted for R8, which is in its fifth year of monitoring. Thirteen species of native trees and shrubs have been planted in this riparian area from 2000-2009. All trees and shrubs installed have an 80% survival performance criterion during the three-year plant establishment period. Years 4 and 5 have a 60% survival criterion. Replacement planting is required if percent survivorship falls below the set criterion for that year.

Table 8. Relative percent cover by native trees, native shrubs, and valley oaks. Numbers that are italicized and in boldface indicate that the benchmark was met or exceeded.

Monitoring year	Site	Relative percent cover		
		Native trees (%)	Native shrubs (%)	Valley oak (%)
Year 5	Performance benchmark	15	7	15
	R8	19.9	11.5	0
Year 6	Performance benchmark	25	10	25
	C3	28.6	10.7	0
Year 7	Performance benchmark	25-35	10-15	25-35
	C7	8.8	17.8	0
Year 8	Performance benchmark	35	15	35
	R6	9.7	9.7	9.7
	R9	19.5	20.0	0
	C18/R11	40.6	9.3	12.8
	R12	74.1	7.4	0.0
Year 9	Performance benchmark	35-50	15-20	35
	R1	15.2	0.0	0.0
	R2/C2	61.5	17.9	7.2
	R3	11.4	19.6	0.5
	R4	41.9	51.2	41.9
	R5	10.2	10.7	0
Year 10	Performance benchmark	50	20	35
	C1	18.6	11.7	3.5
	C4	35.1	24.6	0.0

A number of shrubs have become particularly well-established over the years, with many new root sprouts appearing around the parent plants. This and the persistence of coast live oak saplings transplanted from other parts of the golf club several years ago have helped increase the survivorship of R8 to 101% (Table 9).

4.3 NATURAL REPRODUCTION/RECRUITMENT

Natural reproduction/recruitment of planted species continued during 2010 at all mitigation sites. Native shrub species (i.e., California wild rose, mugwort, Pacific blackberry, common snowberry, and coyote bush) have established well-developed root systems and, consequently, have numerous root sprouts appearing around their parent plants. As a result, these species have

formed dense stands in many areas of the mitigation sites. Naturally reproducing tree species primarily included the valley oak, coast live oak, and red willow. Natural recruitment of target species was observed in more than half of the mitigation sites. It is expected that the existing planted tree species will begin or continue recruiting as they become more established. This criterion has been successfully met and will continue to be a good indicator of success in future monitoring years.

Table 9. Number of trees and shrubs planted, number observed in 2010, and percent survival for site R8.

Monitoring Year	Riparian Site Number		Trees							Shrubs						Total	Percent Survival (%)
			Valley Oak	Coast Live Oak	California Bay	California Sycamore	Red Willow	California Buckeye	Mexican Elderberry	California Wild Rose	Mugwort	Pacific Blackberry	Common Snowberry	Coyote Bush	California Sage		
5	R8	Planted	62	72	1	18	2	34	30	102	11	30	2	60	13	437	101
		Obs.	46	103	1	14	2	7	12	128	12	31	3	60	22	441	

4.4 TREE HEIGHT AND BASAL AREA

An established tree height performance criterion was not specified in the *Mitigation and Monitoring Plan* (1996) until Year 2 (Table 5). Basal area has a set performance criterion beginning in Year 3 (Table 6).

Tree height was measured according to the performance criterion determined in Table 5. Forty-six of the 75 trees surveyed, or 61% of the surveyed trees, met the benchmark performance criterion for tree height (shown in bold and italic in Table 10). This is consistent with the 2009 results, where 64% of the surveyed trees met their benchmark performance criterion. It is expected that the percentage of trees meeting this criterion will remain approximately the same in future years.

Basal area in the riparian and combination areas was measured according to the performance criterion determined in Table 6. Nine of the fourteen sites being monitored for basal area met the required criterion (shown in bold and italics in Table 10) for their respective monitoring year.

Table 10. Tree heights and basal area measurements taken during riparian monitoring in 2010. Numbers that are italicized and in boldface indicate that the benchmark was met or exceeded.

Riparian Number	Monitoring Year	Species	Tree Tag Number	Height (ft)	DBH (in)	Basal Area (ft ² /acre)
C1	10	Valley Oak	1	4.9	1.0	48.7
		Valley Oak	1	4.6	2.2	
		Valley Oak	11	18.0	7.3	
		California Bay	5	1.3	-	
		California Sycamore	12	27.9	17.3	
		California Sycamore	13	23.8	11.2	
		Red Willow	14	9.0	10.0	
		Red Willow	15	12.3	4.1	
C3	6	Valley Oak	1	2.6	0.6	24.3
		California Sycamore	11	13.1	7.7	
		Red Willow	4	9.8	7.3	
C4	10	Valley Oak	1	3.3	0.6	3.5
		Coast Live Oak	2	7.5	1.4	
		California Buckeye	5	3.1	1.2	
		California Sycamore	3	21.3	5.3	
C7	7	California Sycamore	4	18.0	3.3	38.6
		Red Willow	11	16.4	21.1	
		Red Willow	13	10.7	14.4	
		California Buckeye	3	7.4	6.1	
C18, R11	8	Coast Live Oak	1	4.9	1.7	55.7
		Coast Live Oak	4	17.22	5.1	
		Coast Live Oak	13	11.5	6.1	
		California Sycamore	2a	18.9	5.7	
		California Sycamore	12	25.4	4.3	
		Red Willow	2	23.0	19.7	
		Red Willow	3	31.2	14.2	
R1	9	Red Willow	11	33.6	8.1	14.5
		Coast Live Oak	2	9.8	10.2	
		Coast Live Oak	12	7.2	1.8	
		California Sycamore	3	7.9	4.7	
		Red Willow	4	8.2	6.7	
		Mexican Elderberry	13	8.2	2.4	
R2, C2	9	Mexican Elderberry	14	9.0	7.1	20.8
		Valley Oak	1	18.9	6.3	
		Valley Oak	11	16.4	7.3	
		Coast Live Oak	2	32.8	12.2	
		Coast Live Oak	12	8.2	1.8	
		California Bay	3	4.6	2.2	
		California Sycamore	4	19.7	1.8	
		California Buckeye	6	2.5	0.6	
Mexican Elderberry	7	13.1	9.6			

Table 10. Tree heights and basal area measurements taken during riparian monitoring in 2009 (cont'd).

Riparian Number	Monitoring Year	Species	Tree Tag Number	Height (ft)	DBH (in)	Basal Area (ft ² /acre)
R3	9	Valley Oak	11	14.8	7.1	15.6
		Valley Oak	13	14.8	6.3	
		Valley Oak	15	16.4	6.5	
		Coast Live Oak	12	11.5	8.7	
		Coast Live Oak	14	13.1	3.1	
		Coast Live Oak	16	7.9	5.3	
		California Sycamore	4	9.0	6.1	
		Red Willow	5	19.7	17.7	
		California Buckeye	6	3.3	2.6	
		Mexican Elderberry	7	8.5	2.8	
R4	9	Valley Oak	11	17.2	6.5	89.0
		California Bay	3	49.2	15.0	
		California Sycamore	4	18.0	11.2	
		California Buckeye	12	9.8	4.5	
R5	9	Valley Oak	1	16.4	2.4	10.5
		Valley Oak	14	14.8	5.9	
		Coast Live Oak	2	13.1	3.3	
		Coast Live Oak	12	13.1	3.3	
		Coast Live Oak	13	9.8	6.0	
		California Bay	3	1.8	n/a	
R6	8	Valley Oak	1	9.8	2.2	2.2
		Coast Live Oak	2	6.2	3.0	
		Coast Live Oak	3	7.5	2.0	
R8	5	Valley Oak	1	11.5	3.0	11.5
		Valley Oak	12	13.1	6.3	
		Coast Live Oak	11	13.1	3.9	
		California Sycamore	4	14.8	8.3	
		California Sycamore	13	11.5	5.3	
		California Buckeye	6	4.9	3.0	
		Mexican Elderberry	7	7.9	3.5	
R9	8	Coast Live Oak	12	5.6	2.6	2.2
		Coast Live Oak	13	3.3	2.2	
		Coast Live Oak	14	13.1	3.3	
R12	8	Coast Live Oak	1	2.5	0.2	0.01

4.5 PLANT VIGOR AND HEALTH

The overall plant vigor and health of all living tree and shrub species present (dead plants were excluded) at each combination and riparian site was assessed. Species listed as NA were not

present at that particular site; this includes species that have died (health and vigor of 10), as these plants were not included in the count of existing plants. Overall, the success of each species, regardless of the number of individuals present, was positive (Table 11). In summary, high vigor and health ratings (i.e., ratings of 1-3) were assigned to 93% of the surviving species. Medium vigor and health ratings (rating of 4-6) were assigned to 7% of the surviving species. No species were assigned low vigor and health ratings (rating of 7-9) in 2010.

Table 11. Plant vigor and health of trees and shrubs monitored in combination and riparian mitigation sites.

Riparian Number	Valley Oak	Coast Live Oak	California Bay	California Sycamore	Red Willow	California Buckeye	Mexican Elderberry	California Wild Rose	Mugwort	Pacific Blackberry	Common Snowberry	Coyote Bush	California Sage
C1	3	NA	1	2	1	NA	NA	1	NA	NA	NA	1	1
C3	2	1	1	1	2	NA	NA	1	NA	1	NA	1	1
C4	2	1	NA	1	1	2	NA	2	1	2	6	1	NA
C7	5	NA	1	1	1	2	NA	NA	2	2	NA	1	NA
C18, R11	1	1	1	3	1	NA	NA	1	NA	1	NA	2	NA
R1	NA	1	NA	1	NA	NA	1	2	1	3	2	1	5
R2, C2	1	1	1	1	1	5	1	1	1	1	2	1	NA
R3	3	1	NA	1	1	1	1	2	1	5	3	1	2
R4	1	1	1	1	1	1	NA	2	1	1	2	1	NA
R5	1	1	1	1	2	2	3	1	1	NA	NA	1	NA
R6	2	1	NA	NA	NA	6	NA	1	1	1	4	1	NA
R8	1	1	1	2	1	2	1	1	1	1	2	1	2
R9	NA	1	NA	NA	1	NA	NA	1	4	2	NA	1	2
R12	1	1	4	NA	NA	NA	NA	1	NA	1	3	1	NA

4.6 TOTAL AREA OF CONSTRUCTED COMBINATION AND RIPARIAN MITIGATION SITES

Cinnabar Hills Golf Course is required to create 9.60 acres of riparian habitat within the project area. In 2010, the total area of riparian habitat present onsite, totaling 10.17 acres, remained unchanged from previous years (Table 12). Continued maintenance will be required to ensure that the created riparian habitats continue to establish, thereby meeting the final criteria in Year 10. Section 6 discusses adaptive management strategies for 2010 prior to monitoring.

Table 12. Area of riparian and combination mitigation sites.

Site Number	Area of Riparian (acres)			
	2001	2002	2003	2004-2010
R1	0.68	0.64	0.92	0.90
R2	0.33	0.28	0.37	0.30
R3	1.91	1.82	1.55	1.84
R4	0.03	0.13	0.11	0.12
R5	1.34	1.17	1.17	1.17
R6	0.11	0.15	0.15	0.17
R8	1.95	1.89	1.85	1.92
R9	-	0.65	0.63	0.64
R11	-	0.41	0.41	0.50
R12	-	0.18	0.18	0.22
C1	0.56	0.5	0.47	0.54
C2	0.27	0.28	0.27	0.30
C3	0.47	0.52	0.44	0.48
C4	0.42	0.44	0.31	0.52
C7	0.18	0.18	0.37	0.37
C18	0.21	0.19	0.19	0.18
Total	8.46	9.43	9.39	10.17

4.7 SITE MAINTENANCE

Because all sites met the survivorship criterion in 2009, no additional plantings were required for the 2010 monitoring season. Overall, the mitigation areas continue to be well-maintained and controlled for weeds and rodents. Irrigation systems are inspected on at least a monthly basis, and, as the sites have become more established, the irrigation for each site has shifted from a site-level regime to an individual regime (i.e., only plantings that appear to require supplemental water are receiving it).

5.0 DISCUSSION

5.1 ALL SITES

All mitigation sites continue to show steady progress towards meeting the final success criteria set forth in the *Tradition Golf Club, Mitigation and Monitoring Plan* and continue to demonstrate that the installed mitigation plantings are becoming well-established on the sites. Site R8 met the survivorship criterion due, in part, to well-developed root systems that have allowed these plantings to spread. In 2010, 61% of the sampled trees met the required tree height, and 64% of the sites met the basal area performance criterion; this has declined only slightly from 2009 results and is generally consistent from year to year. Overall, the mitigation trees are growing and healthy.

However, while their vigor and health continues to be high, a number of planted trees in the mitigation areas are below the benchmark heights for their species and, in some cases, tree height remains the same from year to year. These trees may not meet the final success criterion for tree height as rapidly as was expected, if at all, and, therefore, they may affect a site achieving the final success criterion for percent cover and basal area as well.

It should be noted that the benchmark and final criteria were arbitrarily established based on a generic growth curve for these species and did not take into consideration site characteristics. As discussed in Section 4.7, all mitigation sites are well-maintained. These growth patterns likely are a result of the specific abiotic and biotic factors that are peculiar to this site and, therefore, not modifiable by human intervention. Thus, the arbitrary tree height standard established in the *Tradition Golf Club, Mitigation and Monitoring Plan*, and its correlation with percent cover and basal area, should not be the sole determinants of whether or not a particular mitigation site has succeeded or failed, overriding the fact that they have become a healthy and self-sustaining riparian area. The primary goal of the mitigation is to establish a self-sustaining riparian woodland that would develop its own ecological equilibrium. This certainly seems to be what is occurring on the mitigation sites at Cinnabar Hills Golf Club. A number of external environmental factors, such as slope, aspect, light exposure, climate-related constraints, and the physical properties of soils that affect the soils' water-holding capacity, aeration, and available

minerals and nutrients, likely influence the growth of trees and shrubs at each mitigation site and should be taken into consideration when assessing the final success or failure of a restoration site. When considered with other important quantitative and qualitative benchmarks such as plant survivorship and overall health and vigor, these sites should be considered successful.

Additionally, only one site met the valley oak association benchmark. Again, not meeting this criterion should not determine the success or failure of a particular mitigation site. This criterion should be evaluated within the context of other factors, such as the number of valley oaks planted at each site and the amount of cover provided by other tree species, which contributes to the overall diversity of species at each site.

5.2 YEAR 10 SITES

Two sites, C1 and C4, are in their tenth and final year of monitoring. These two sites represent a combined area of 1.06 acres of created riparian habitat. Site C1 met the final performance criteria for tree height and basal area. Site C4 met the final performance criteria for native shrub cover. While they did not meet all of the final performance criteria, it should be noted that plant survivorship for both sites remained at over 80% (in those years where survivorship data was recorded), overall plant health and vigor has been good to fair, and percent native tree and shrub cover for both of these sites have remained consistent over the years. All of these characters indicate that these sites are self-sustaining and have reached an ecological equilibrium that is adapted to the environmental conditions of their particular location (Section 5.1).

6.0 RECOMMENDATIONS

6.1 ADDITIONAL PLANTINGS

During the 2010 monitoring, 10.17 acres, exceeding the required 9.60 acres, of created riparian habitat were determined to be present. For site R8, the remaining site still in its first five years of monitoring, plant survivorship exceeded the required 80% survival rate. Therefore, no additional plantings are required for the 2011 monitoring season.

6.2 SITE MAINTENANCE

Continued efforts should be made in 2010 to clear out ruderal vegetation, control for rodents, and monitor irrigation systems so that the installed riparian plantings can establish well-developed root systems. Weeds should be kept clear around all individuals planted in the riparian and combination sites. Tall weeds outcompete planted individuals and encourage rodents to burrow near these sensitive plants. If weeds are kept to a minimum, the young plants and saplings are better able to obtain the nutrients and sunlight that they need. Also, raptors can more easily hunt for problematic rodents if they have a clear view of the ground.

In general, the coast live oaks, willows, and sycamores appear to establish more successfully than valley oaks, bays, buckeyes, and elderberries. While the irrigation system around all plantings should be regularly inspected and maintained throughout the year, emphasis should be placed on weed control and adequate irrigation for these species. Particular attention should also be paid to sites R1, R3, and R8, which support younger plantings, elderberries, and valley oaks that may require more frequent weed control and irrigation system inspections.

A continued effort should be made to ensure that no vehicles or golfers enter the mitigation sites. Waste, leaf litter, and grass cuttings from areas outside the mitigation sites should not be discarded within the mitigation sites, as this can lead to adverse ecological effects within the mitigation sites.

We also recommend ceasing irrigation at those sites that appear to be relatively well-established to see if the installed plantings will persist on their own. This includes sites C18/R11, R2/C2,

R3, R4, R5, R6, and R12. (Any plantings installed within the last three years in these areas should continue to be irrigated.) We will continue to monitor these sites on at least a quarterly basis for signs of water-stress; if the plants appear to be stressed, then irrigation will resume.

Following the rainy season, drip irrigation systems need to be fully functional in all riparian and combination sites where irrigation is still recommended. The irrigation systems should be monitored on at least a monthly basis. Young plants are sensitive to getting too much or too little water, so the amount of water being supplied to the plants should be closely watched to observe any adverse effects they may be having on the mitigation sites.

A qualified biologist should visit the mitigation sites on at least a quarterly basis to monitor site maintenance.

6.3 MONITORING IN 2011

The riparian and combination sites will be monitored in 2011 for the riparian criteria established for Years 1-10, depending on the site. Five sites—R1, R2/C2, R3, R4, and R5—will be monitored for the final performance criteria. Per the *Tradition Golf Club, Mitigation and Monitoring Plan* (1996), sites in Year 6 of monitoring and above will no longer be monitored for percent survivorship. Rather, percent cover measurements will become the primary indicator of plant establishment rates. In 2011, no sites will be in their first five years of monitoring.

The *Tradition Golf Club, Mitigation and Monitoring Plan* (1996) does not require sites in Years 7 and 9 to be monitored (Section 2.0). However, per the client, all sites, regardless of monitoring year, will be monitored in 2011. Table 13 divides the sites into monitoring year and gives the justification for their categorization.

Table 13. Riparian monitoring criteria to be used in 2011 for the riparian and combination sites.

Monitoring Year	Riparian Site	Reason
Year 6	R8	Percent survival greater than 60%
Year 7	C3	Percent survival greater than 60%
Year 8	C7	Percent survival greater than 60%
Year 9	R6	Percent survival greater than 60%
	R9	Percent survival greater than 60%
	C18, R11	Percent survival greater than 60%
	R12	Percent survival greater than 60%
Year 10	R1	Percent survival greater than 60%
	R2, C2	Percent survival greater than 60%
	R3	Percent survival greater than 60%
	R4	Percent survival greater than 60%
	R5	Percent survival greater than 60%
Completed	C1	Percent survival greater than 60%
	C4	Percent survival greater than 60%

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<i>Raphanus sativus</i>	Wild Radish	UPL
<i>Rorippa nasturtium-aquaticum</i>	Watercress	OBL
CAPRIFOLIACEAE – Honeysuckle Family		
<i>Symphoricarpos albus</i>	Snowberry	FACU
CARYOPHYLLACEAE – Pink Family		
<i>Silene gallica</i>	Windmill Pink	UPL
<i>Silene</i> sp.	Campion	-
<i>Spergularia rubra</i>	Purple Sandspurry	FAC-
<i>Stellaria media</i>	Common Chickweed	FACU
CHENOPODIACEAE – Goosefoot Family		
<i>Chenopodium californicum</i>	California Goosefoot	FAC*
CONVOLVULACEAE – Morning Glory Family		
<i>Convolvulus arvensis</i>	Bindweed	UPL
CUSCUTACEAE – Dodder Family		
<i>Cuscuta</i> sp.	Dodder	UPL
CYPERACEAE – Sedge Family		
<i>Carex</i> sp.	Sedge	FACW
<i>Cyperus eragrostis</i>	Tall Flatsedge	FACW
<i>Eleocharis pauciflora</i>	Fewflower Spikerush	OBL
<i>Scirpus</i> sp.	Bulrush	OBL
EUPHORBIACEAE – Spurge Family		
<i>Eremocarpus setigerus</i>	Doveweed	UPL
FABACEAE – Pea Family		
<i>Lotus corniculatus</i>	Birdfoot Trefoil	FAC
<i>Lotus humistratus</i>	Hill Lotus	UPL
<i>Lotus purshianus</i>	Spanish Clover	UPL
<i>Lotus scoparius</i>	Deerweed	UPL
<i>Lotus</i> sp.	Lotus	-
<i>Lotus wrangelianus</i>	California Lotus	UPL
<i>Lupinus bicolor</i>	Miniature Lupine	UPL
<i>Lupinus</i> sp.	Lupine	-
<i>Medicago polymorpha</i>	Bur Clover	UPL
<i>Melilotus indica</i>	Sourclover	FAC
<i>Trifolium dubium</i>	Hop Clover	FACU
<i>Trifolium ciliolatum</i>	Tree Clover	UPL
<i>Trifolium hirtum</i>	Rose Clover	UPL
<i>Trifolium hybridum</i>	Alsike Clover	FACU
<i>Trifolium microcephalum</i>	Small-head Clover	FACU
<i>Trifolium willdenovii</i>	Tomcat Clover	UPL
<i>Trifolium wormskioldii</i>	Cows Clover	FACW
<i>Trifolium</i> sp.	Clover	-
<i>Vicia sativa</i>	Common Clover	FACU
<i>Vicia</i> sp.	Vetch	-
FAGACEAE – Oak Family		
<i>Quercus agrifolia</i>	Coast Live Oak	UPL
<i>Quercus douglassii</i>	Blue Oak	UPL
<i>Quercus lobata</i>	Valley Oak	FAC*
GERANIACEAE – Geranium Family		
<i>Erodium botrys</i>	Long-Beaked Filaree	FACU*
<i>Erodium cicutarium</i>	Erodium	UPL

<i>Geranium bicknellii</i>	Bicknell Geranium	UPL
<i>Geranium dissectum</i>	Cut-Leaved Geranium	UPL
<i>Geranium sp.</i>	Geranium	-
JUNCACEAE - Rush Family		
<i>Juncus balticus</i>	Baltic Rush	OBL
<i>Juncus bufonius</i>	Toad Rush	FACW+
<i>Juncus effusus</i>	Soft Rush	OBL
<i>Juncus mexicanus</i>	Mexican Rush	FACW
<i>Juncus xiphioides</i>	Iris-leaf Juncus	OBL
LAMIACEAE – Mint Family		
<i>Mentha pulegium</i>	Pennyroyal	OBL
<i>Trichostema lanceolatum</i>	Vinegar Weed	UPL
LAURACEAE – Laurel Family		
<i>Umbellularia californica</i>	California Bay	FAC
LEMNACEAE – Duckweed Family		
<i>Lemna minor</i>	Duckweed	OBL
LILIACEAE – Lily Family		
<i>Triteleia laxa</i>	Ithuriel's Sphere	UPL
ONAGRACEAE – Evening Primrose Family		
<i>Epilobium brachycarpum</i>	Panicled Willow-herb	UPL
<i>Epilobium ciliatum</i>	Hairy Willow-herb	FACW
<i>Epilobium sp.</i>	Willow-herb	FACW
PAPAVERACEAE – Poppy Family		
<i>Eschscholzia californica</i>	California Poppy	UPL
PLANTAGINACEAE – Plantain Family		
<i>Plantago lanceolata</i>	English Plantain	FAC-
<i>Plantago sp.</i>	Plantain	-
PLATANACEAE – Sycamore Family		
<i>Platanus racemosa</i>	Western Sycamore	FACW
POACEAE - Grass Family		
<i>Agrostis viridis</i>	Bentgrass	UPL
<i>Aira caryophyllea</i>	Silver Hairgrass	UPL
<i>Avena barbata</i>	Slender Wild Oats	UPL
<i>Briza minor</i>	Little Quaking Grass	FACW-
<i>Bromus carinatus</i>	California Brome	UPL
<i>Bromus diandrus</i>	Ripgut	UPL
<i>Bromus hordaceus</i>	Soft Chess	FACU-
<i>Bromus madritensis</i>	Red Brome	UPL
<i>Bromus sp.</i>	Brome	-
<i>Cynodon dactylon</i>	Bermuda Grass	FAC
<i>Dactylis glomerula</i>	Orchard Grass	FACU
<i>Gastridium ventricosum</i>	Nitgrass	FACU
<i>Hordeum brachyantherum</i>	Meadow Barley	FACW
<i>Hordeum marinum ssp. gussoneanum</i>	Mediterranean Barley	FAC
<i>Hordeum murinum ssp. leporinum</i>	Wild Barley	UPL
<i>Hordeum sp.</i>	Barley	-
<i>Leymus triticoides</i>	Creeping Wild Rye	FACW
<i>Lolium multiflorum</i>	Italian Ryegrass	UPL
<i>Lolium perenne</i>	Perennial Ryegrass	FAC*
<i>Nassella pulchra</i>	Purple Needlegrass	UPL

<i>Phalaris arundinacea</i>	Reed Canary Grass	OBL
<i>Phalaris sp.</i>	Canary Grass	-
<i>Phalaris aquatica</i>	Harding Grass	FAC +
<i>Poa annua</i>	Annual Blue Grass	FAC
<i>Poa secunda</i>	One-Sided Blue Grass	UPL
<i>Polygonum amphibium</i>	Knotweed	OBL
<i>Polygonum arenastrum</i>	Common Knotweed	UPL
<i>Polypogon monspeliensis</i>	Rabbitsfoot Grass	FACW+
<i>Sisyrinchium bellum</i>	Blue-eyed Grass	FAC
Turf Grass	Turf Grass	UPL
<i>Vulpia myuros</i>	Rat-tail Fescue	FACU
POLEMONIACEAE - Phlox Family		
<i>Linanthus bicolor</i>	Bicolor linanthus	UPL
POLYGONACEAE - Buckwheat Family		
<i>Polygonum amphibium</i>	Knotweed	OBL
<i>Polygonum arenastrum</i>	Common Knotweed	UPL
<i>Rumex acetosella</i>	Sheep Sorrel	FAC-
<i>Rumex crispus</i>	Curly Dock	FACW-
<i>Rumex sp.</i>	Dock	-
PRIMULACEAE – Primrose Family		
<i>Anagallis arvensis</i>	Scarlet Pimpernel	FAC
ROSACEAE – Rose Family		
<i>Rosa californica</i>	Wild Rose	FAC+
<i>Rubus ursinus</i>	California Blackberry	FACW*
RUBIACEAE – Madder Family		
<i>Galium aparine</i>	Catchweed Bedstraw	FACU
SALICACEAE – Willow Family		
<i>Populus fremontii</i>	Fremont Cottonwood	FACW
<i>Salix laevigata</i>	Red Willow	UPL
<i>Salix lasiolepis</i>	Arroyo Willow	FACW
<i>Salix sp.</i>	Willow	NI
SCROPHULARIACEAE – Figwort Family		
<i>Mimulus guttatus</i>	Common Monkey-Flower	OBL
TYPHACEAE - Cattail Family		
<i>Typha augustifolia</i>	Narrow-leaved Cattail	OBL

APPENDIX B: PHOTODOCUMENTATION OF THE MITIGATION SITES IN 2010



Site C3 (Year 6)*



Site C7 (Year 7)*

* Disregard year on photo. All photos were taken in October 2010.



Site R9 (Year 8)*



Sites C18 and R11 (Year 8)*

* Disregard year on photo. All photos were taken in October 2010.



Sites R3 and C3 (Years 9 and 6, respectively)*



Site R1 (Year 9)*

* Disregard year on photo. All photos were taken in October 2010.



Sites C4 and R12 (Years 10 and 8, respectively)*



Site C1 (Year 10)*

* Disregard year on photo. All photos were taken in October 2010.