MONITORING REPORT
WILLOWY MONARDELLA (MONARDELLA VIMINEA)
HABITAT ENHANCEMENT 2011
AT
MARINE CORPS AIR STATION MIRAMAR, SAN DIEGO, CALIFORNIA

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EXECUTIVE SUMMARY

Willowy monardella *(Monardella viminea)* is a federally endangered plant species found along stream courses in relatively protected west facing canyons of the Marine Corps Air Station Miramar (Station). The goal of this project is to test the effect of various controls on exotic species, especially exotic grasses, on the vigor and recruitment of willowy monardella. This report describes the site conditions at five sites in West Sycamore, Spring, and San Clemente Canyons, and reports on willowy monardella status at the treatment sites in May 2011 following three years of treatment activity. It details monitoring activities during 2011 of the five sites, and reports on the results of the monitoring. It also serves as a final report for the project, summarizes results from the previous years, and provides interpretations and recommendations.

Data was collected through the use of 20-meter transects placed in each treatment area, including controls, which were evaluated with a point intercept method as well as with quadrats placed along the transect. Selected plants were measured for height and lateral dimension, and were scored for vigor and for impacts of herbivory and disturbance. The data were subjected to statistical analysis. In addition, all *M. viminea* plants previously identified and labeled within the study areas were re-located, and the numbers noted and position recorded with Global Positioning System (GPS) units.

The monitoring shows that the plants grew slightly between 2010 and 2011. Other population parameters measured were similar to those recorded in 2010. There was no statistically significant relationship between growth and treatment, although the plants were slightly larger in the treatment plots. Presence of *M. viminea* is significantly correlated with lower cover of non-native grass (NNG), indicating that reduced cover of NNG may present favorable conditions for establishment of the plant. NNG cover was significantly lower in the treated plots. Recruitment exceeded mortality during this sampling interval, with 19 new plants recorded and only 13 losses. Herbivory at the time of sampling, which was done earlier than in previous years, was negligible. The data suggest that heavy episodic rainfall early in the season, followed by moderate precipitation into the late spring may be an important variable in determining population recruitment from seedlings. Erosion within the cobbled channels where *M. viminea* commonly establishes is probably also a factor in mortality.

Overall during the three years of sampling, there were 25 plants that have been recruited to the populations since 2009, and 13 plants that have been lost, either through death, herbivory, or to floods. The populations have grown by a net of 12 plants, or by about 3 % over three years.

Suggestions for further action to enhance habitat are discussed, and they include the creation and seeding of occasional new "seedbeds" with low competition managed with weeding; and control of natural herbivory by exclusion of deer and rabbits.

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ACRONYMS AND ABBREVIATIONS

AMEC	AMEC Earth & Environmental, Inc.
ANOVA	Analysis of Variance
C	Control treatment
GPS	Global Positioning System
NNG	Non-Native Grass
Station	Marine Corps Air Station Miramar
W	Weed and herbicide treatment
W/T	Weed and thatch treatment
WMEA	Willowy monardella enhancement area

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1.0 INTRODUCTION

Willowy monardella *(Monardella viminea)* is a perennial herb in the mint family restricted to coastal canyons of San Diego County. Populations of this federally endangered plant species were studied at localized sites along stream courses in three relatively protected west facing canyons of the Marine Corps Air Station Miramar (Station).

The recovery of the Miramar willowy monardella populations following a devastating wildfire in 2003 has possibly been affected by the expansion of exotic annual grasses and other impacts. Monitoring results in 2005-2006 appeared to indicate a significant and rapid decline in numbers within the known Miramar occurrences (Tierra Data 2005 and AMEC Earth & Environmental, Inc. [AMEC] 2007).

The *Endangered Willowy Monardella (Monardella viminea) Habitat Enhancement Project* (AMEC 2007) was performed to test the effect of interventions involving herbicide treatment and removal of exotic species, especially exotic grasses, on the vigor and recruitment of willowy monardella. Three treatments have been tested, and are here compared to each other and to a Control (C):

1. Removal of live competing grasses through herbicide application (Weed, or W),
2. Herbicide application combined with the removal of grass thatch (Weed/Thatch, or W/T),
3. Placement of rock cobble around monardella to provide rock mulch (Cobble).

A controlled treatment block design was developed and implemented to test the interventions at five sites within the known population area. Results from the first season of monitoring (2009) suggested that variation in plant height and canopy volume was randomly distributed among the four canyon sites, exotic grasses had been suppressed in treatment areas, and the plants in some of the treated areas were larger than in untreated areas based on canopy volume. Herbivory, including seed predation, had been noted as a possibly important factor in plant health. Recruitment of new plants was minimal.

In May 2011, following three years of treatment activity, the monitoring showed that the plants grew by about 15 percent between 2009 and 2011. There was no statistically significant relationship between growth and treatment, although the plants were slightly larger in the treatment plots. Presence of *M. viminea* was significantly correlated at most sites with lower cover of non-native grass (NNG), indicating that reduced cover of NNG may present favorable conditions for establishment and survivorship of the plant. High episodic water flow within the cobbled channels where *M. viminea* commonly establishes was probably a factor both in mortality through erosion and in recruitment.

This report describes site conditions in May 2011 at all five sites. It reports on monitoring activities for the project during 2011. The report includes a presentation of the data collected at, and summarizes other activities and observations made from the sites in 2011. It concludes with recommendations for future activities and data interpretation.

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2.0 PURPOSE

The purpose of the May 2011 field effort was to document population trends and treatment conditions within the identified treatment blocks at the five sites. The 2009 data established the level of normal variation in measured variables and described the homogeneity of variance among treatment blocks. These evaluations determined the adequacy of the data collection for statistical interpretation. The 2010 data allowed for more detailed interpretation of the effect of the treatments compared to natural variability among sites. This final sampling effort will describe the effects of the treatment after three years.

2.1 Description of Enhancement Sites and Treatment Histories

A total of five willowy monardella enhancement areas (WMEAs) were studied for habitat enhancement activities (Figure 1). There were four sites established in previous years, and the fifth site was added in 2010. In order for each WMEA to be readily located during enhancement and monitoring activities, the boundary of each WMEA was delineated in the field by four metal fence posts and recorded using a Trimble GeoXT submeter global positioning system (GPS) device.

Initial treatments and site conditions were described in the February 2010 annual report (AMEC 2010) and in the March 2011 annual report (AMEC 2011). In February 2011, herbicide and thatch treatments (W and W/T) were repeated at all five sites. Treatment consisted of hand weeding where necessary around existing willowy monardella plants, and then applying herbicide to remaining exotic species only, including non-native grasses, in both treatment plots at the site (W treatment). Herbicide applicators took care to assure that no herbicide was applied to willowy monardella plants. Biomass removal was also performed in the weed and thatch (W/T) treatment plot.

The five sites are briefly described below. Maps and photographs of the sites are contained in Appendix A, with figure numbers referenced as a number preceded by an “A”.

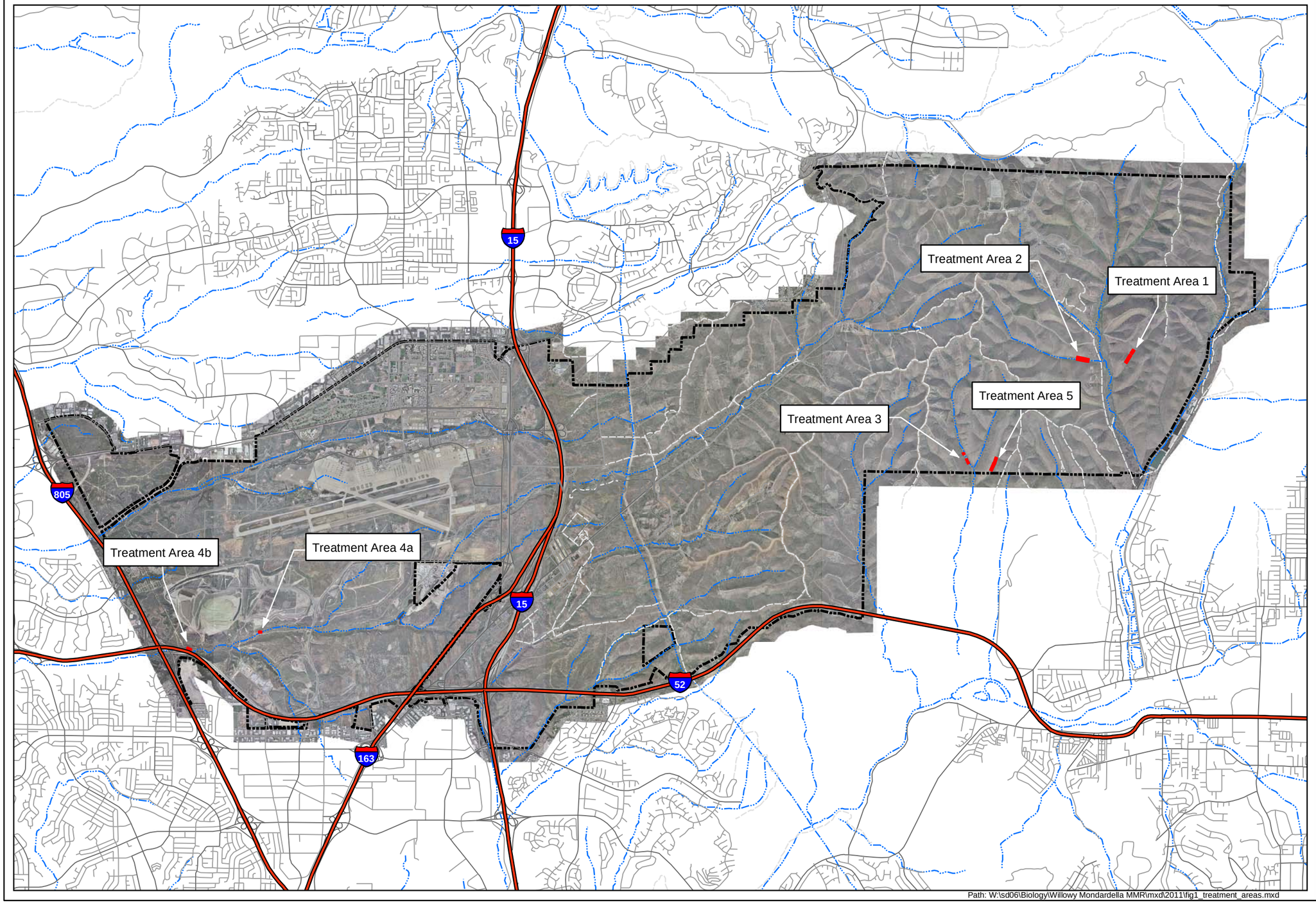
WMEA Site 1

WMEA 1 is located in the middle east branch of West Sycamore Canyon (Figure A1). The canyon at this location is relatively narrow, including low terraces associated with stream meanders. The stream channel is narrow and well-defined, with many cobbles, and rather sharp meanders. Willowy monardella plants are generally associated with the channel and the low terraces, with almost half of the ones censused in or at the edge of the channel. WMEA 1 is broken into four sections; one area for treatment W, one area for treatment W/T, and two C sections, placed up and down stream. Cobble treatments were placed around selected willowy monardella plants within each treatment area. Figures A2a-e show the site and its habitat, as well as the location and habitat of the transects in each sampled area. In May 2011, 11 new willowy monardella seedlings were found in the channels in Control area A (10 seedlings) and Control area B (one seedling).

WMEA Site 2

WMEA 2 is located along the middle west branch of West Sycamore Canyon (Figure A3). This site is in a canyon of similar dimensions, but the stream channel is more diffuse. The area occupied by active channel is broader than at WMEA 1, and the channels are braided and wider. Fewer than one quarter of the willowy monardella plants censused at this site were in the channel or at channel edges. Rather, they occupied the terraces between channel segments. Overall, fewer plants were observed at this site than at WMEA 1. WMEA 2 is broken into three sections; one area for treatment W, one area for treatment W/T, and one C section. Cobbles were placed around selected willowy monardella plants in each treatment area. The habitat in WMEA 2 and the location of the transects in each treatment area are shown in Figures A4a-d.

Two willowy monardella seedlings had been found at this location on 16 April 2009. Both seedlings were in the W/T treatment area. Additional seedlings were found at the same site in February 2010. Two new seedlings were found in May 2011 in channel of the W/T area, as well as a mature plant captured in flotsam in the channel of the W treatment area.



Legend

- Treatment Area
- Miramar Boundary
- Major Drainages

Roads

- Paved
- Unimproved
- Dirt
- Freeways

Map Notes

Data Source:
MCAS Miramar- Air Station Boundary,
2004 3-band Color Image
Roads on Base
AMEC - Treatment Areas

SANDAG - Freeways
Roads off Base
Major Drainages

Projection: Stateplane, California 406
NAD 83, Feet

Date: 1/5/2011

N

1 inch = 1 mile

0 0.5 1 Miles

Path: W:\sd06\Biology\Willowy Mondardella MMR\mxd\2011\fig1_treatment_areas.mxd

amec

Willowy Monardella Treatment Areas
Endangered Willowy Monardella Habitat Enhancement Project
Marine Corps Air Station Miramar

FIGURE
1

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WMEA Site 3

WMEA 3 is located along the west branch of Spring Canyon (Figure A5). This canyon is also rather wide, and the channel in it is very broad and relatively straight. The plants censused here were most commonly found in or associated with the stream channel, as there was less area of low terraces caused by stream meanders. This site had the fewest plants censused. WMEA 3 is broken into three sections; one area for treatment W, one area for treatment W/T, and one C section with no treatments. Cobble was placed around selected willowy monardella plants within each treatment area. In May 2011, there were two new seedlings were found, one each in the channel of the W and the W/T areas of this site.

Figures A6a-d show the habitat at this site, and the location and habitat of each transect.

WMEA Site 4

WMEA 4 is an alluvial bench habitat adjacent to sycamore alluvial woodland in the relatively wide flood plain of San Clemente Canyon. There are just two treatment sites in WMEA 4, and they are separated from each other. WMEA 4a is the C site, and WMEA 4b is the treatment site (Figure A7). The control site is located on an old stream terrace that is over 5 feet above the active stream channel. The plants here appear older, and are reproducing exclusively with ramets; no seedlings were found. The treatment site was also associated with terraces, but about a third of the plants located there were associated with the stream channel and with shrubby vegetation. At the treatment site, the W and W/T treatments were combined. This site was hand-weeded with some spot spraying and did not require large scale dethatching. Figures A8a-d show the sites and transects at the time of the May 2011 sampling. One new seedling was found at the W/T area in May 2011.

WMEA Site 5

WMEA is located in the East Fork of Spring Canyon. This canyon is rather broad, but has a narrowly defined channel. The channel has sharp meanders, and was eroded rather severely during the storms of 2010-2011. This WMEA has experienced a decrease in willowy monardella individuals since 2002. The plants in this WMEA growing nearest the stream bottom and along the channel edges account for almost half of all plants censused; the remainder are in upland areas including low terraces associated with channel meanders. NNG were especially vigorous in this area in the control segments. A recreational (mountain bike) trail runs through the center of the population.

WMEA 5 is broken into three segments; one that is designated for W treatment, one for W/T treatment, and a C site with no treatments (Figure A9).

Figures A10a-d show WMEA 5 at the time of sampling in May 2011.

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3.0 MONITORING METHODS

Data was collected through the use of 20-meter transects placed in each treatment area, including controls, in a diagonal, or 45-degree angle to the general trend of the stream. This orientation was selected in order to increase the probability that the landscape heterogeneity was properly sampled, and to help capture enough points for increased power and precision in the data interpretation. Previously established transects were re-located for Sites 1-4. For Site 5 in all treatments, and at Site 2 in the control treatment, the 2010 transects could not be re-located, and so new transects of the same length and general orientation were established in May 2011.

The transects at all sites were monitored May 23-25, 2011 for cover and surface characteristics as well as for species richness for both native and non-native plant species. Monitoring of the willowy monardella plants for plant dimension and condition was conducted at the same time. We note that in previous years, plant monitoring was conducted later in the season (late July), and this difference may affect the data interpretation, as herbivory is more pronounced and plant development more mature later in the season. All sites and all treatments were monitored. Three treatment types were evaluated at each WMEA: C, W, and W/T. Exceptions were that only one treatment (W/T) was implemented at Site 4, and there are two C plots at Site 1. Therefore, there are a total of 15 individual treatment plots.

Two methods of data collection were utilized along each transect. The first method for collecting data was the point-intercept method. Data was collected by using a narrow metal pin (approximately 1/8 inch in diameter) placed every 0.5 meter (totaling 40 points evaluated on each transect). Data was recorded for each species intersected by the pin in both the herb and the shrub layer . Data regarding ground cover was additionally collected and classified into three categories: Rock, Bare (only dirt is present), and Litter (any material that is not rock, dirt or live plant).

The second method for collecting data along each transect was through the use 20 quadrats (50 cm x 50 cm or 0.25 m^2) which were placed every meter along each transect. The placement of the quadrat was alternated from one side to the other along the transect line. Non-native and native plant species were counted in each quadrat, and the cover within the quadrat was visually estimated and recorded.

Within each WMEA treatment plot, all live willowy monardella plants were identified and tagged with a metal marker that indicates the site location, the treatment area, and the plant number. In addition, another project monitoring willowy monardella in these canyons has placed blue metal tags at most plants, with a different numbering system. We provide in Table C1 in Appendix C reference for the numbers used by both projects. This will allow for enhanced monitoring in the future if plant measurements are continued. Locations of all plants were recorded by a sub-meter accuracy GPS device. A subsample of individual plants within each treatment area was measured for the parameters discussed below. The measured plants were the first 12 plants encountered in each treatment area when the area was surveyed moving in an upstream direction. There was no indication that this selection method resulted in any bias, as the plants were not distributed in any particular geographic manner within the treatment areas. An

exception was in WMEA Site 4 Control, where a random subsample of 12 plants, a similar number to those sampled plants in other plots, was measured.

Parameters measured for each of the willowy monardella plants sampled were:

- height (measured from the ground to the highest living material on the plant)
- long diameter (longest axis of the plant's canopy measured parallel to the ground)
- perpendicular diameter (measurement of plant canopy taken at the widest point perpendicular to the long diameter)

From the height and the two diameter measures, "elliptical cover" and "hemispherical volume" can be calculated. Elliptical cover is defined as the elliptical surface area calculated using the mean of the long and perpendicular axis radii, and is a calculation of the projected cover of the plant. Hemispherical volume is the product of the height, longest axis, and perpendicular axis, and is the volume of the canopy, or the plant "size". The data for the hemispheric volume measurement has been reduced to cubic decimeter units for simplicity of statistical comparisons, and further transformed using a base 10 log of the calculated value for statistical evaluation. The log transformation produces a normal distribution of otherwise strongly skewed dimension data, and permits normal means testing of the dataset.

These calculations provide a measure of the plant condition, and allow us to state quantifiably how "big" the plant is. The elliptical cover shows how much space it takes up as an element of the vegetation cover, and the hemispherical volume shows how much space the plant occupies three-dimensionally.

In addition, a 5-class vigor estimate and a 3-class herbivory estimate were made for each measured plant. The vigor codes are in Table 1, and the herbivory codes are in Table 2.

During this sampling, herbivory was largely absent, which may be a function of the early season, as herbivory has been recorded as being rather severe in previous years when the sample was taken in mid-to-late summer. Other data noted included cobble treatment condition, shrub associates, disturbance, and approximate flowering effort. These notes were not quantitative, but are anecdotal in nature.

Table 1. Vigor Codes for Willowy Monardella Used in 2011

Scale	Condition
4 = Excellent	• Plant robust • Many leaves • Strong robust stems • Many, large flower heads • A “spectacular” plant
3 = Good	• Growth good but not exceedingly good • Multiple leaves on each or most stems • Stems appear normal • Multiple flower heads • An “average” plant
2 = Fair	• Growth stable but not remarkable • Few leaves • Thin or “spindly” stems • Few, small flower heads
1 = Marginal	• Very few or no flower heads • Plant is not thriving • Evidence of decline in past season
0 = Dead	• Plant dead • Dried or no leaves • Brittle stems (snap test) • No flower heads

Table 2. Herbivory Codes for Willowy Monardella Used in 2011

Code	Condition
S = Severe herbivory	• Extensive pruning of stems (s) **and/or** • Extensive boring or consumption of leaves (l) **and/or** • Extensive pruning of flower heads (f) **and/or** • Extensive insect damage to flower heads (i)
M = Minor herbivory	• Stems pruned somewhat (s) **and/or** • Some leaves bored or eaten (l) **and/or** • Some flower heads eaten off (f) **and/or** • Some damage (insect boring) to flower heads (i)
N= None visible	• No pruning of stems (s) • No visible leaf boring or signs of animal bites (l) • No visible pruning of flower heads (f) • No visible damage (insect boring) to flower heads (i)

4.0 RESULTS

4.1 Demographic Data Summary

4.1.1 Total Population Census

Plant counts were made during the monitoring activities of 2011. There were 368 recorded willowy monardella plants in 15 treatment blocks at 5 sites (Table 3 and Appendix C). Note that there are two control sites in WMEA 1. The most plants were recorded in the populations in WMEA 1, in the east branch of West Sycamore Canyon. The East branch of Spring Canyon was the second most populous, and the west branch of Spring Canyon has the sparsest population.

Table 3. Total Recorded *M. viminea* at WMEAs in 2011

	WMEA 1 West Sycamore East	WMEA 2 West Sycamore West	WMEA 3 Spring West	WMEA 4 San Clemente*	WMEA 5 Spring East	Total
Site Number	1	2	3	4	5	
Control	102 (12 new)	11	3	39	22	177
Weed	43 (2 new)	14 (2 new)	7 (1 new)		19 (2 new)	83
Weed / Thatch	40	19 (2 new)	10 (2 new)	12 (2 new)	27	108
Site Total	185	44	20	51	68	368

We review here the complete census data for the three years of the project. During these years (2009 – 2011), 381 plants were located and identified. As of 2011, there were 343 plants that had been present and accounted for during all three years. There were 19 seedlings found and marked in 2011, and 6 plants that had not been located in 2010, but were found in 2011. Other additions to the population included seedlings from 2010 (two seedlings), and one plant that washed in on flood waters in 2011 and was captured in the flotsam upstream of a downed tree, and has rooted into the streambed. Finally, there are 13 plants that appear to have been permanently lost to the censused populations. We have, then, 25 plants that have been recruited to the populations since 2009, and 13 plants that have been lost, either through death, herbivory, or to floods. The populations have grown by a net of 12 plants, or by about 3 % over two years. Of the 19 seedlings found in 2011, 11 were found at WMEA 1 in the East branch of West Sycamore Canyon. The remainder of the seedlings were distributed more or less equally among the other four WMEAs.

4.1.2 Plant Dimension Census

Evaluation of the data from the measured plants in the 2009 investigation indicated that the number of plants measured represents an adequate statistical subsample of the plants in the population for height and width dimensions (AMEC 2010). Plants selected for measurement in 2011 were the same individuals sampled in 2009 and 2010 from WMEAs 1-4, and from 2010 only in WMEA 5, providing a repeated measures sample. A few new plants were added to the measurement cohort in 2011 to replace plants that had been lost to flooding or had otherwise disappeared from the population. A total of 169 plants were measured in 2011 (Table 4).

Table 4. Number of *M. viminea* Plants Measured at WMEAs in 2011

	WMEA 1 West Sycamore East	WMEA 2 West Sycamore West	WMEA 3 Spring West	WMEA 4 San Clemente	WMEA 5 Spring East	
Site Number	**1**	**2**	**3**	**4**	**5**	**Treatment Total**
Control	24	11	3	12	15	65
Weed	14	12	6		13	45
Weed/ Thatch	14	13	8	10	14	59
Site Total	52	36	17	22	42	169

Changes in the 2011 measured populations were as follows:

Site 1 – 1 new plant in Control area, 1 plant gone in Weed area
Site 2 – 1 plant gone in Weed area; 3 plants gone in Weed/Thatch area
Site 3 -- 1 plant gone in Weed/Thatch area
Site 4 – 1 plant gone in Weed/Thatch area

These changes, and the overall tallies of plants included in the measurement work, are summarized in Table 5. This table shows that in all, 183 separate individuals have been measured in 2009, 2010, and/or 2011. The data in Table 5 are grouped by WMEA and canyon, and separated by treatment.

Table 5. Summary of *M. viminea* Plants Measured in 2009-2011

Number	Category
114	Sampled all three years
42	added from new WMEA 5 in 2010
9	new plants added for measurement in expanded sampling within old blocks
2	newly discovered or new recruitment, and included in measurements
16	plants sampled in 2009 but not in 2010 or 2011 (missing, dead, or 2009 individuals merged into a clump and treated as a single plant in 2010)
183	Total database measured individuals

4.2 Dimension Data Summary

Mean measures of the physical dimensions (height, longest axis, and perpendicular axis), and the calculated cover (area) and volume (hemisphere) show some variation among plants in the WMEAs, canyons and treatments. Tables 6, 7, and 8 show mean plant height, mean plant projected cover area, and mean hemispherical volume in the five WMEAs and the three treatments.

Although measured plants were significantly larger in 2010 than in 2009 ($p<0.001$) when plant height, area and hemispheric volume were compared, the same trend does not continue between 2010 and 2011. Between 2009 and 2010, plant dimension was correlated between the two years with a moderate regression coefficient, ($r^2= 0.87$) and a linear regression slope indicating that growth between the two years was about 15% in cover area dimension (AMEC 2011). Between 2010 and 2011, however, plant dimension was somewhat less strongly correlated (r2=0.71), and the linear regression slope indicated that the plants were slightly smaller (y = 0.998) (Figure 2). This may be due to the fact that the plants were sampled earlier in the season before full plant expansion occurred, especially in advance of the full extension of the flowering stems.

To assist in interpreting the dimension data, we note that willowy monardella is suffrutescent in growth form. The bulk of the canopy grows from a root crown annually. Some branches become woody and grow for several seasons, expanding in size; but the bulk of the plant dimension consists of young twigs rising from a permanent base. The effect of this growth form is to make plant dimension data a proxy for root crown vigor, and thus growth from year to year is not the result of the extension of older existing branches.

Table 6. 2011 Survey: Mean Height *M. viminea* Plants

	WMEA 1 West Sycamore East	WMEA 2 West Sycamore West	WMEA 3 Spring West	WMEA 4 San Clemente	WMEA 5 Spring East	
Site Number	**1**	**2**	**3**	**4**	**5**	**Treatment Mean**
Control	59.4 (18.1)	70.9 (12.9)	52.0(8.1)	43.8 (11.7)	50.3 (12.0)	55.8 (16.7)
Weed	64.1 (10.7)	67.1 (17.4)	55.6 (15.0)		56.3 (9.0)	61.3 (13.5)
Weed/Thatch	63.3 (9.6)	50.7 (9.6)	57.3 (7.6)	37.4 (10.1)	62.8 (10.4)	55.4 (13.2)
Site Mean	61.5 (14.4)	62.5 (15.7)	59.3 (10.3)	41.0 (11.3)	56.3 (11.7)	57.2 (14.9)

(units are cm); standard deviation in (parentheses)

Table 7. 2011 Survey: Mean Projected Cover *M. viminea* Plants

	WMEA 1 West Sycamore East	WMEA 2 West Sycamore West	WMEA 3 Spring West	WMEA 4 San Clemente	WMEA 5 Spring East	
Site Number	**1**	**2**	**3**	**4**	**5**	**Treatment Mean**
Control	0.918 (0.835)	1.708 (0.809)	0.465 (0.259)	0.757 (0.819)	1.240 (0.719)	1.076 (0.939)
Weed	1.025 (1.210)	0.734 (0.639)	1.128 (0.540)		1.608 (0.816)	1.128 (0.929)
Weed/Thatch	1.206 (0.399)	0.318 (0.215)	1.221 (0.693)	0.426 (0.363)	1.698 (0.906)	1.007 (0.769)
Site Mean	1.025 (0.862)	0.897 (0.808)	1.047 (0.627)	0.609 (0.661)	1.506 (0.821)	1.064 (0.837)

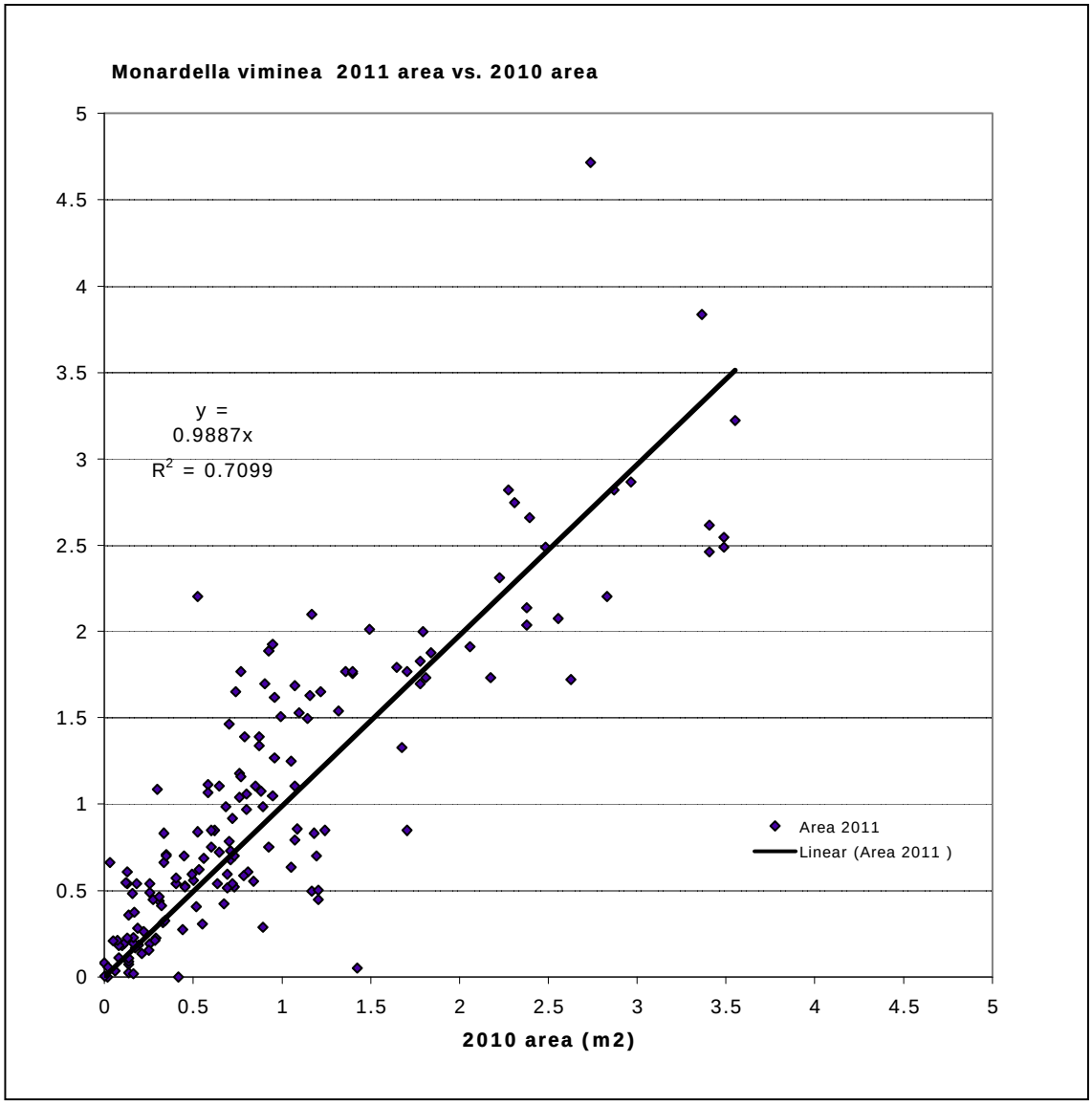
(units are m2); standard deviation in (parentheses)

Table 8. 2011 Survey: Mean Volume *M. viminea* Plants

	WMEA 1 West Sycamore West	WMEA 2 West Sycamore East	WMEA 3 Spring West	WMEA 4 San Clemente	WMEA 5 Spring East	Treatment Mean
Site Number	**1**	**2**	**3**	**4**	**5**	
Control	4.16 (4.14)	8.40 (4.94)	1.65 (0.93)	2.49 (3.04)	4.26 (2.53)	4.45 (4.09)
Weed	4.73 (6.05)	3.71 (4.05)	4.55 (2.83)		6.17 (3.31)	4.85 (4.44)
Weed/Thatch	5.23 (2.29)	1.35 (0.99)	4.67 (2.67)	1.16 (1.05)	7.38 (4.44)	4.12 (3.60)
Site Mean	4.60 (4.32)	4.29 (4.59)	4.10 (2.67)	1.91 (2.44)	5.89 (3.66)	4.44 (4.01)

units are dm^3; standard deviation in (parentheses)

Figure 2. Regression Line for Elliptical Area of *M. viminea* Between 2010 and 2011



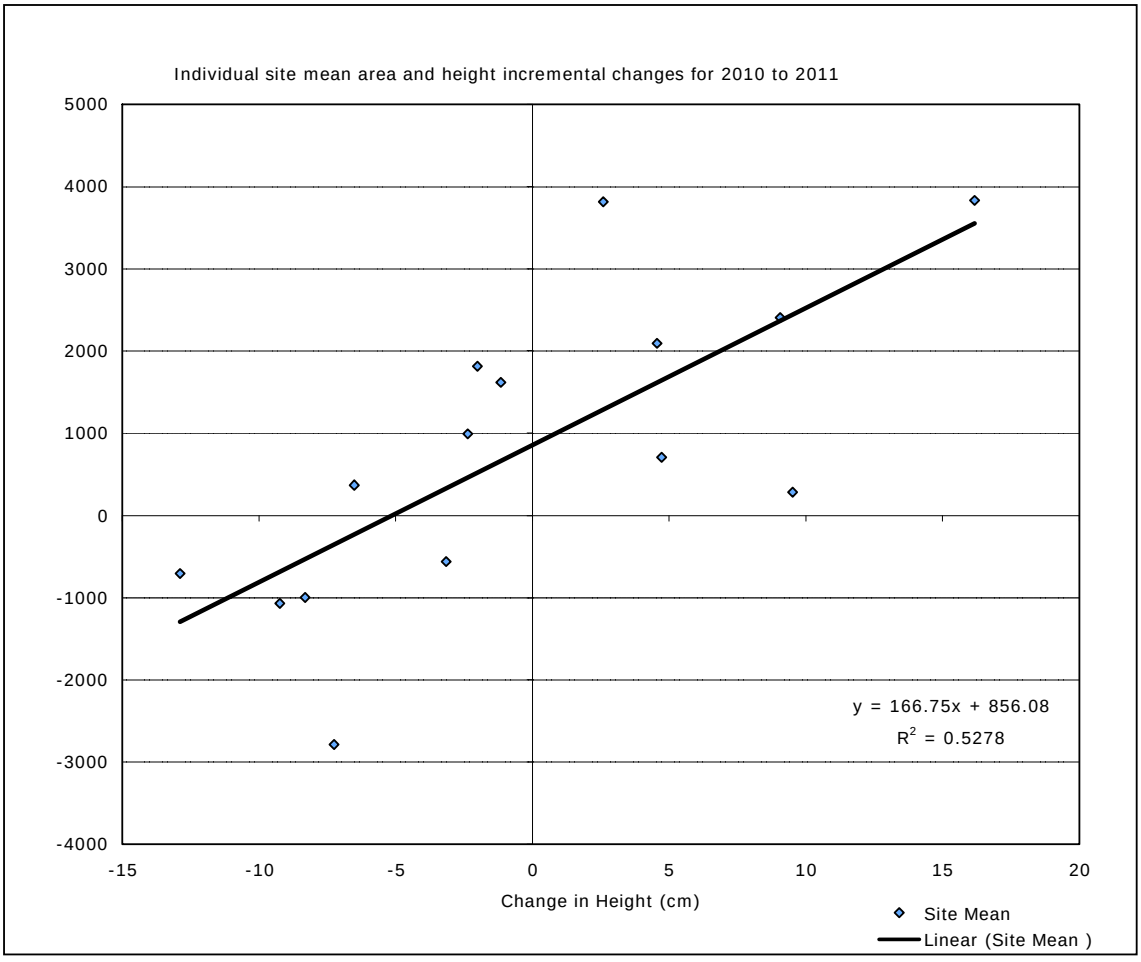
A closer look, however, shows that not all the sites exhibit overall growth in willowy monardella plant volume, and that not all the plants are growing.

The regression line on Figure 2 measures the trend line of points, not the mean. There are many plants with small dimensions and a few very large ones; the trend line is being controlled or leveraged by dimensions recorded for the large plants. The large plants were (on average) more or less static in size, although there is broad dispersion. The small plants were (on average) larger in 2011 than they were the previous year. Smaller plants

have less statistical "leverage" to influence the line due to the clustered nature of the sample points and the overall smaller values. Other regression models were tested to fit the data. A 2nd order polynomial model raises the R^2 value of the regression by an insignificant 0.043 (0.703 to 0.746).

Figure 3 explores the trajectory of change for individual site means for plant height and elliptical area. Sites for which the data showed a positive shift in elliptical area of plants also had plants with a positive height growth; conversely, sites for which the data showed smaller mean plant size also had plants of lower stature. There are three Control sites represented in the negative category below the regression line (WMEA 2, 4, and 5), which reinforces the observation that plants at some sites are being affected by NNG. These results indicate that site location and weed removal may be most important in determining plant growth rates.

Figure 3. Correlation between Height and Elliptical Area for Individual Site Means

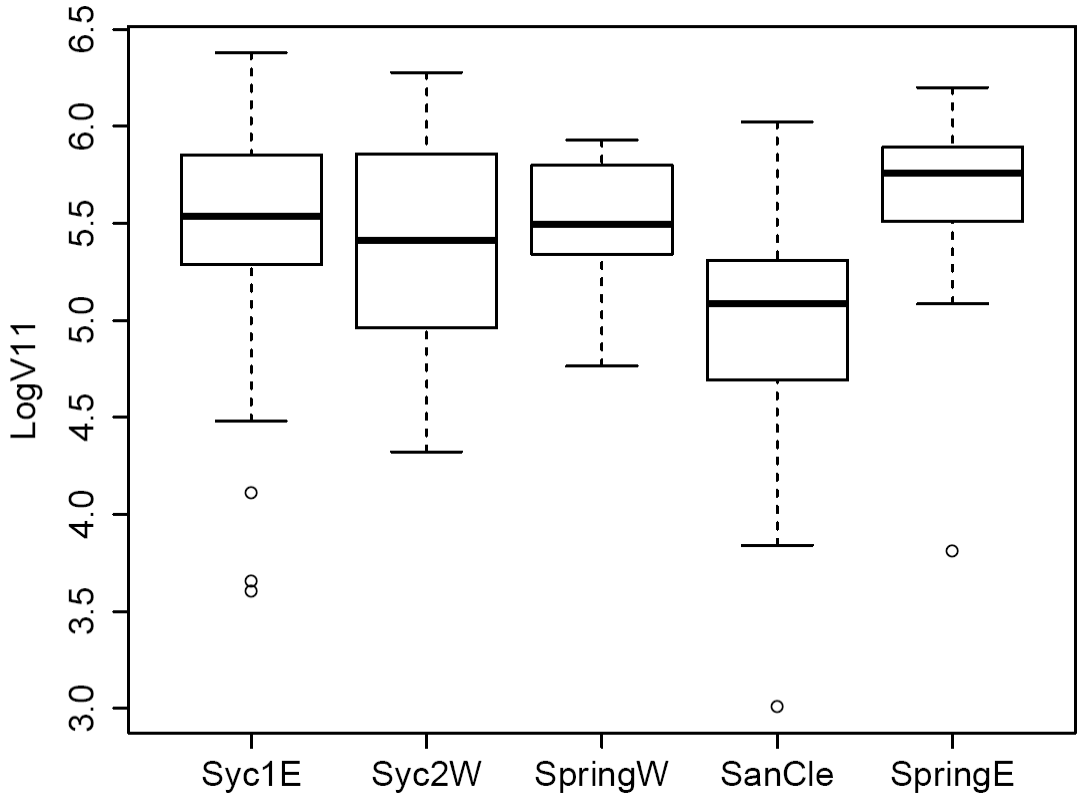


Again, similar to the situation in 2010, there were no significant differences in 2011 in plant heights recorded among surface treatments, and the cobble treatment did not appear to have any effect on plant dimension.

Uncontrolled for other variables, plants showed significantly different ($p < 0.001$) base dimension of log-transformed elliptical area in 2011 at different sites. This finding of significant difference is an effect of the distinctly smaller mean size of plants at San Clemente Canyon (WMEA 4) especially at the WT area. The plant dimensions at the other four sites show no significance in difference amongst this *ad hoc* selection for any of the measured or calculated dimension variables. The effect of San Clemente Canyon plant size also controls the findings of significance for other variables: elliptical area, and raw dimension variables.

The discussion section of this report addresses the likely historical development of the WMEA 4 incised stream hydrology which we believe contributes to the smaller mean dimension of plants at that site (Figure 4).

Figure 4. Hemispheric Volume of *M. viminea* at 5 Sites in 2011



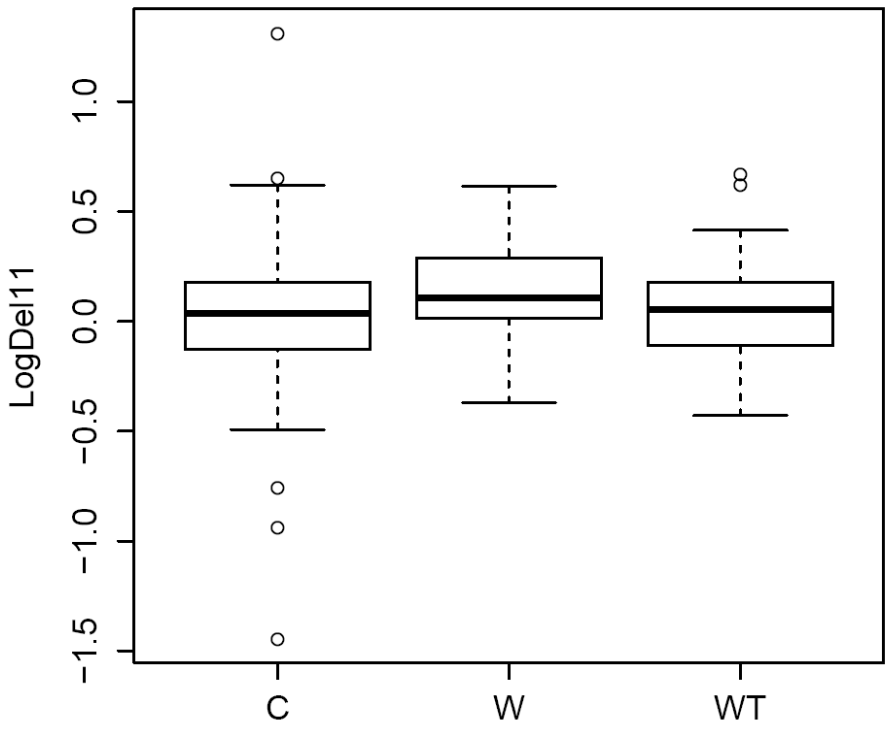
Dimension data are presented in a Tukey Boxplot (Tukey 1977). These plots are also known as "box and whisker" plots. The box represents the 1st and 3rd interquartile range, which is the 25% and 75% distribution limit of the dataset. The belt line is the data

median, or 50th percentile. The whiskers (vertical dashed lines) represent the maximum value, exclusive of outliers. The open circles are outlier data (greater than 1.5 times the inter-quartile median in the 1st and 4th quartile). Tukey boxplots are used here and in subsequent charts because they present in very compact form information the central tendency, the 50% distribution, and the skew and kurtosis (peakedness) in the data set, as well as highlighting outlier data.

The data were also evaluated for differences among the three treatments. Figure 4 summarizes those data, and shows that uncontrolled for any other variables, no significant difference existed among the base dimension for the three block treatments, and no significant difference was present among the treatments for mean change in dimension between 2010 and 2011. That is, there is no evidence that the treatments affected the measured dimensions in 2011, as the tests for dimension variable compared to treatment are insignificant. This is true of raw measurements (Height, Long Axis, etc.) as well as for the calculated and transformed dimensions (e.g. Elliptical Area and log Elliptical Area).

There is, however, slight evidence that the treatments affected the growth rate of the plants in some treatments between 2010 and 2011. At the $p<0.1$ level, a difference exists between Delta Log Area (2010-2011) for the Weed treatment plants, which show a greater positive increase in log area than other treatments at the marginally significant 10% probability level (Figure 5).

Figure 5. Change in *M. viminea* Dimension Year-to-Year (2010 t0 2011) of Log-Transformed Cover Area (Log Delta) vs. Treatment Regime



4.3 Cobble Effect

Also evaluated was the effect of cobble treatment (Table 9). The year over year change in elliptical area shows a difference at the $p<0.05$ (5%) level. Cobble plants show a greater mean change in area than non-cobbled plants. The change in elliptical area from the 2010 data when calculated as the mean of the change shown for all *individuals* (not the mean of the entire *population* as shown in Table 9 below) is 0.24 m^2 for Cobble and 0.05 m^2 for No Cobble.

Table 9. Elliptical Area (m2) of Cobble-Treated *M. viminea* Plants (2011)

Cobble Code		Mean	SD	N
No Cobble		1.072	0.89	138
Cobble		1.038	0.57	31

4.4 Herbivory

Herbivory was largely absent in all plants at all locations and treatments in 2011 (Table 10). As noted above, this is probably a consequence of the earlier sampling period, as herbivory increases as the dry season progresses and there are few green plants available for the principal browsers, which appear to be deer and rabbits. During the 2011 census, the great majority of plants evaluated were in excellent condition and unaffected by herbivory.

Table 10. Tally of Vigor of *M. viminea* by Herbivory Code (2011)

Herbivory	0 (Dead)	1 (Poor)	2 (Fair)	3 (Good)	3.5 (Good +)	4 (Excel.)
No Herbivory	0	0	1	29	4	129
Light	0	0		0	0	4
Moderate	0	0	1	0	0	2
Severe	0	0	0	0	0	0

4.5 Vigor

Most plants in the 2011 survey were judged to be in good to excellent condition (Table 11). This judgment was based on minimal herbivory, evidence of growth that extended beyond the stems from the previous year, and production of buds or flowers.

Table 11. Tally of *M. viminea* Plants in Vigor Class by Treatment (2011)

Herbivory	0 (Dead)	1 (Poor)	2 (Fair)	3 (Good)	3.5 (Good +)	4 (Excel.)
Control	0	0	1 (2%)	17 (26%)	2 (3%)	46 (70%)
Weed	0	0	0	6 (13%)	1 (2%)	38 (85%)
Weed / Thatch	0	0	1(2%)	6 (10%)	1 (2%)	51(86%)
Total	0	0	2	29	4	135 (79%)

However, vigor data are sorted by site as well (Table 12), with a lower proportion of plants judged in excellent condition in WMEA Site 4 in San Clemente Canyon and WMEA Site 3 in West Sycamore Canyon. This fact indicates that an unmeasured ecological effect is likely a larger influence on plant condition.

Table 12. Tally of Vigor Class by Survey Area (2011)

Herbivory	0 (Dead)	1 (Poor)	2 (Fair)	3 (Good)	3.5 (Good +)	4 (Excel.)
West Sycamore East WMEA 1	0	0	1 (2%)	5 (9%)	0	46 (88%)
West Sycamore West WMEA 2	0	0	0	5 (14%)	1 (3%)	30 (83%)
Spring West WMEA 3	0	0		5 (29%)	1 (6%)	11 (65%)
San Clemente WMEA 4	0	0	1 (4%)	9 (39%)	1 (4%)	12 (52%)
Spring East, WMEA 5	0	0	0	5 (11%)	1 (2%)	36 (86%)

4.6 Species Richness Data

Total species richness at all sites is shown in Appendix A. Numbers of species cumulatively observed between 2008 and 2010 at each site is shown in Table 13. No new species observations were made in 2011. For WMEA 5, the species noted are only for 2010. The lower species diversity in WMEA 4 reflects the dominance of shrubs at that site.

Table 13. Species Richness (Native and Non-Native) Observed in the Years 2008 – 2011 at WMEAs

Type	WMEA 1 West Sycamore East	WMEA 2 West Sycamore West	WMEA 3 Spring West	WMEA 4 San Clemente	WMEA 5 Spring East
Native	82	85	73	85	35
Sensitive	2	2	2	2	1
Non-native	19	19	20	26	22
Invasive	6	6	5	6	9
Total	**101**	**104**	**93**	**57**	**111**

Shrub cover was highest in San Clemente Canyon, followed by West Sycamore Canyon, and then Spring Canyon. (Table14). Overall, the cover category most frequently represented was “empty”, due to the removal of NNG in the treatment sites, and to the fact that each transect spanned various lengths of cobbled surface in the streambeds which was largely devoid of vegetation.

Table 14. Proportion of Point-hit Data in Life-form Category in 2011

	San Clemente Canyon		Spring Canyon		West Sycamore Canyon		Overall
	Control	Treatment	Control	Treatment	Control	Treatment	
Empty	23%	23%	25%	65%	34%	67%	48%
Any Grass/Forb	33%	53%	70%	12%	48%	26%	35%
Any Shrub	45%	25%	5%	23%	18%	7%	17%

4.7 Cover Data

4.7.1 Total Plant Cover

Total plant cover was estimated by point-intercept proportion (n=40 in each of 12 transects) and additionally by quadrats sampled in each treatment (n=20 in each of 12 treatment plots). In an analysis of the 2009 data (AMEC 2009), the two independent measures of total cover showed significant correlation and some consistent variation between canyons. For the interpretation of cover that can be seen as an “actual” value, quadrat data are generally more repeatable and are reported in Table 15.

Table 15. Total Plant Cover (Percent) of Treatment Blocks Measured by Quadrat Estimates (2011)

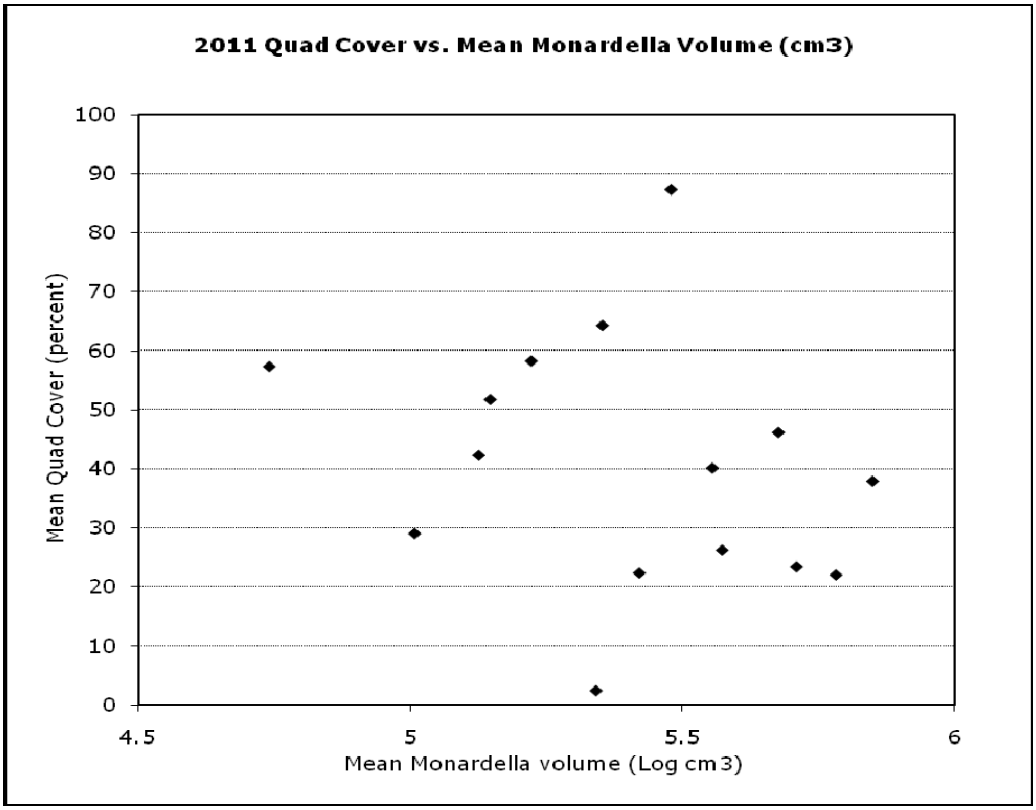
	WMEA 1 West Sycamore East	WMEA 2 West Sycamore West	WMEA 3 Spring West	WMEA 4 San Clemente	WMEA 5 Spring East	Treatment Mean Total
Control	61	38	52	42	87	57
Weed	22	3	40		24	22
Weed Thatch	46	29	26	57	22	36
Site overall	48	23	39	50	44	41

A cross tabulation of cover by treatment and site shows large inter-canyon variation. Differences are significant at the $p<0.001$ level, but are un-interpretable because the trend of variation is not consistent across treatment groups. This was the case in 2010, and has not changed in 2011. Again, this is simply a function of the idiosyncratic placement of transects with a random proportion of habitat that is accounted for by the in-stream cobbled rock area. Also, a qualitative difference may exist between WMEA 4 (San Clemente) and the other sites. A higher proportion of plot cover in San Clemente canyon site is represented by native perennial shrubs (especially *Eriogonum fasciculatum)*, rather than NNG species. Associated with this difference in dominant species mix is the observation that the willowy monardella plants are smaller on average in the San Clemente population. Overall plant cover tends to be higher in the Weed/Thatch areas of WMEA 4, as the weeding and thatching took place just around willowy monardella plants rather than over the area as a whole, so shrubbier sites tended to have greater plant cover regardless of treatment.

4.7.2 Relationships of Cover to Plant Dimensions

The relationship between the canopy volume of individual willowy monardella plants and plot cover was also examined. Over all plots sampled, there is no significant correlation of *M. viminea* plant dimensions with total mean plot cover (Figure 6). The data show the points relating site cover and plant volume to be scattered, with no correlation between site cover and willowy monardella plant size.

Figure 6. Scatter Plot of *M. viminea* Plant Volume vs. Plot Cover



4.8 Influence of Exotic Grasses

The data show that total plant cover and NNG cover are much lower in treatment blocks than in control blocks (Table 16). This finding indicates that the prescribed treatment is being carried out successfully, and native grasses are in fact removed by the herbicide and de-thatching operations.

Table 16. Total Non-Native Grass Cover in Quadrats 2011

Treatment	Mean (%)	SD	N
Control	39.3	35.2	125
Weed	5.1	9.3	85
Weed thatch	17.1	23	105
Overall	22.8	29.9	315

The data also show that an inverse relationship exists between non-native plant cover and the recorded presence of *M. viminea* in sampled quadrats (Table 17). A total of 25 sampled quadrats had *M. viminea* in them, and the mean NNG cover was 9.96 percent. With the exception of the Weed treatment, the cover for quadrats containing *M. viminea* is lower than the cover in quadrats without *M. viminea*.

This correlation, however, is weak. A significant effect ($p<5\%$) is found in an ANOVA (analysis of variance) model test of the presence of *M. viminea* and the recorded percentage of non-native plant cover. Quadrats with *M. viminea* recorded averaged about 10% non-native cover, and quadrats without the species average nearly 24% non-native cover. The high variability inherent in quadrat measures over a variety of substrates including cobbled streambed, however, obscured the significance of the inverse correlation (Table 17).

Table 17. Non-native Grass Cover (Percent) Stratified by Presence or Absence of *M. viminea* in 2011

	Mean % NNG	SD	N
M. viminea absent	23.88	30.37	290
M. viminea in quadrat	9.96	20.69	25

A cross tabulation of total cover by treatment and site (Table 18) shows large inter-canyon variation. Differences are significant at the $p< 0.001$ level. The trend of higher NNG cover in the control plots compared to the Weed treatments and the Weed/Thatch treatments is consistent except for WMEA 4 in San Clemente Canyon. This is because the removal of NNG at the treatment site in this canyon was done only around the widely scattered *M. viminea* plants, none of which were present along the transect itself. Cover of NNG in this canyon is therefore not different between the control and the treatment sites.

Table 18. Cover (percent) of Non-native Grass Cross Tabulated by Site and Treatment. 2011

	WMEA 1 West Sycamore East	WMEA 2 West Sycamore West	WMEA 3 Spring West	WMEA 4 San Clemente	WMEA 5 Spring East	Treatment Mean Total
Control	38	19	34	20	87	39
Weed	2	1	8		9	5
Weed Thatch	19	13	11	36	6	17
Site overall	24	11	18	28	34	23

This cross-tabulation of sites and treatments for NNG cover shows that the prescribed treatment is effective in meeting the management goal of suppression of NNG, as these grasses are largely absent from the Weed plots at all sites. In the Weed/Thatch areas, reduction in NNG is sometimes less pronounced, as the treatments were conducted in the immediate vicinity of the willowy monardella plants rather than over the entire area. This is especially true in WMEA 4.

4.9 Disturbance and Precipitation

Thirty-two *M. viminea* plants were given disturbance ratings in 2011, compared with 23 plants in 2010. Fourteen plants coded for disturbance had erosion noted as a factor, and 18 had debris impacts noted, such as having been buried in sand, or washed over. Debris coded plants showed significantly larger dimensions, but this effect is auto-correlated with WMEA 5 where plants in general were significantly larger than at the other sites. In 2011, plants coded as having experienced "washover" were marginally larger than plants with no such disturbance code. The log elliptical area was 4.02 m^2 for washover coded plants (n=21) but was only 3.827 m^2 for plants unaffected by washover (n=149) . The significance of this difference is very marginal at $p<0.1$ or the 10% level. The difference is probably a correlation artifact of plants located in or adjacent to streambeds compared to upland plants, as the plants close to a watercourse tend to be larger.

Figure 7 shows a photo of a willowy monardella plant on the edge of a streambed with the soil around its roots eroded. This is possibly a mechanism by which mature plants are removed from the population.

In 2011, the sampling followed a winter with somewhat greater than average rainfall distributed in pulses over the precipitation season (Figure 8). This chart shows intense rainfall in December 2010 followed by relatively consistent precipitation in February through April 2011. This pattern is consistent with pronounced channel erosion and seed dispersal early in the season, followed by good conditions for establishment of seedlings. Substantial stream flow was evident in at least some of the channels where willowy monardella is found. There were a total of 19 new plants found in the treatment areas, all of them in or at the edges of the cobbly channels. (Figure 9). The largest number of new plants was found at WMEA 1, in the east fork of West Sycamore Canyon. This channel is intermediate in its width and steepness. Water flow would have been rapid, but was slow enough to have deposited seeds among cobbles where they were able to take root.

WMEA 2 was also the location of the greatest number of plants lost to the population, apparently as a result of having been washed away by flood waters. In San Clemente Canyon (WMEA 4), there were two new seedlings noted, in the Weed/Thatch area downstream. Here, the stream flow is slow, and did not apparently have enough energy to wash many seeds down into the channels. At WMEA 5, the channel is very narrow and steep, and the rapid flow caused a great deal of erosion, but did not favor plant establishment.

Figure 7. *M. viminea* Plant Near Stream Channel at WMEA 3 (Spring Canyon West), with Root Zone Eroded

Figure 8. Pattern of Precipitation for 2010-2011. From *ClimateStations.com*

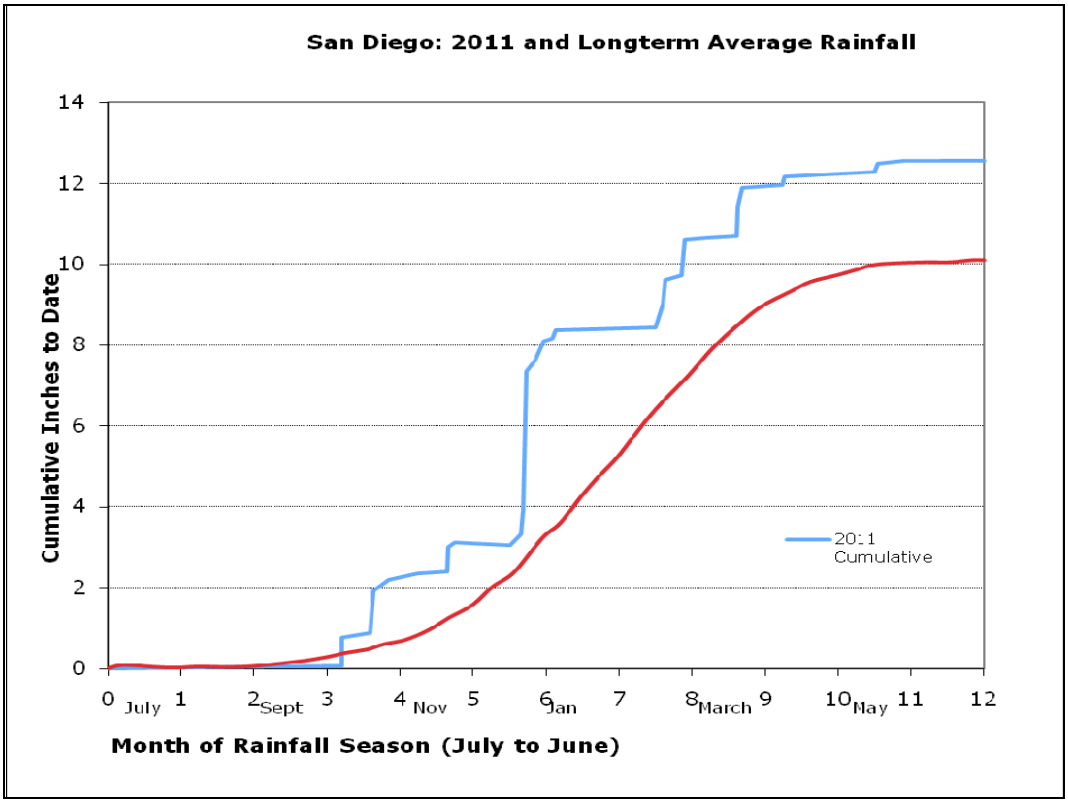


Figure 9. *M. viminea* Seedling in Cobbles of Streambed

5.0 MORTALITY

Mortality in 2011 was minimal, with causes that appear to relate largely to erosion, as discussed below. We examined the data for *M. viminea* plants that had been present in 2010 but not found in 2011. Only 13 plants were lost from the entire censused population, five of which had been part of the measured sub-population. Two of these were gone from the Weed/Thatch area of WMEA 2, one from the Weed/Thatch area of WMEA 3, and two from the Weed/Thatch area of WMEA 4. Only one of these missing plants had been coded as having been in or adjacent to a stream channel. Of the remaining eight missing plants, all were gone from the Weed/Thatch area of WMEA 2.

Year-to-year mortality appears to have moderated compared to previous years (AMEC 2010 and 2011). Three dead plants were recorded and 16 plants were missing from the measured sub-population between 2009 and 2010. In 2011, all plants in the population at all sites were sought and recorded. Between 2010 and 2011, there were 13 plants that were missing from that complete census of 381 total recorded plants, or a mortality rate of 3.4 percent. The fate of the missing plants is not explicitly known. Field observations, however, suggest that at least some of the missing plants were removed from the site by erosion, as they were located adjacent to active channels (see Section 4.9). Recruitment, however, was much increased with 19 new individuals added to the database, which is an addition of almost 5 percent to the population. In this year, recruitment was greater than mortality.

During both the 2010 and 2011 surveys, *M. viminea* plants recorded had been coded as to their location in or near a streambed, so the data could be examined for this locational criterion (see Appendix C). Several plants appeared to have been lost from the streambeds, presumably due to floods. For others, the cause of disappearance was not obvious. We note, however, that in WMEA 2, a mature plant had been washed into the site, captured as flotsam on a log fallen across the stream. Plants gone from the channels of the WMEA sites under study may have lodged somewhere downstream and are not in fact dead.

At the time of the 2011 sample, herbivory was not an obvious cause of plant stress or mortality. In fact, some plants that had been scored as dead or nearly dead in July 2010 were located and scored as healthy in 2011. As noted above, herbivory is probably far more intense during mid to late summer than during the spring. Severe herbivory may in fact cause plant mortality, but many plants can also recover at least for a time from the herbivory and live to grow and set seed during the following growing season. Willowy monardella's suffrutescent growth form is well adapted to repeated severe herbivory, as plants can re-grow from a protected perennial root crown annually.

Year-over-year mortality in the sampled populations as shown in Table 19 shows 13 losses out of a total of 349 censused plants, or about 3.7 percent. Recruitment of 19 new plants amounts to an increase of 5.4 percent, for a net gain of 1.7 percent during this year.

Table 19. Comprehensive tally of *Monardella viminea* within Survey Blocks

Canyon	SITE	Treat	Existing	Seedling	Older, new discovery*	Known Lost* or Dead	TOTAL
West Sycamore East	1	C A	36	9	2	0	47
		C B	54	1	0	0	55
		W	41	1	1	2	45
		WT	40	0	0	0	40
Sub Total			**171**	**11**	**3**	**2**	**187**
West Sycamore West	2	C	11	0	0	0	11
		W	12	1	1	1	15
		WT	17	2	0	7	26
Sub Total			**40**	**3**	**1**	**8**	**52**
Spring West	3	C	3	0	0	0	3
		W	6	1	0	0	7
		WT	8	1	1	1	11
Sub Total			**17**	**2**	**1**	**1**	**21**
San Clemente	4	C	39	0	0	1	40
		WT	10	2	0	1	13
Sub Total			**49**	**2**	**0**	**2**	**53**
Spring East	5	C	22	0	0	0	22
		W	17	1	1	0	19
		WT	27	0	0	0	27
Sub Total			**66**	**1**	**1**	**0**	**68**
Overall Total			**343**	**19**	**6**	**13**	**381**

Losses may have occurred in Years 2010 or 2011. New discovery may represent mature plants swept into survey area by floodwaters in 2011.

6.0 DISCUSSION

We noted in the report from 2010 (AMEC 2011) that an early establishment phase for willowy monardella may have been impacted post-fire by grass competition. The data show that the worst performing site in terms of plant dimension and growth was the WMEA 5 Control, which confirms field observations. Other sites with plants that showed poor performance for growth and dimension were WMEAs 2, 3, and 4 Weed/Thatch areas. The plants at the WMEA 1 sites are doing very well, irrespective of control or treatment; growth of plants at WMEA 2 Weed and WMEA 5 Weed/Thatch were also strongly positive.

We also noted that the lack of substantial recruitment detected in 2009 and 2010 surveys indicates that populations are likely established in single cohorts with recruitment following some sort of periodic disturbance or climatic event, including certain precipitation patterns.

Fewer new plants were found in the west fork of West Sycamore Canyon (WMEA 2), or in the west fork of Spring Canyon (WMEA 3). Both of these sites have broader, braided channels that passed a great deal of water. In fact, there was one new plant identified at WMEA 2 that was quite large, and had apparently been dislodged from further upstream and was captured in a mass of flotsam in the channel.

It is clear that willow monardella plants establish during years of precipitation that is episodic, at least briefly intense, and which occasions some degree of flooding. The flooding appears to have two central functions as relates to plant recruitment. One is the establishment of bars on the inside curves of the streams; these bars being composed of sand and cobbles. This is an ideal substrate for the willowy monardella (Rebman and Dossey 2006). Second, the flooding distributes seeds that wash into the channel from plants that are already established at the channel edges. Of the plants that we censused, 64 of a total of 170 plants (37 percent) were identified as being near the channel, or in the channel. Many of the remaining ones were on terraces on the inside of the curve of the stream channel. Storm events that dislodge seeds or even whole plants, and which create bars, are important events in the recruitment of willowy monardella.

At WMEA 4 in the Control area (San Clemente Canyon upper site), there is a less inviting site condition as regards recruitment and growth than is present in the other population sites. The stream channel is deeply incised (about 2 meters below the old stream terrace). There is no active overflow or meander area, which is where plants have become established on the other sites. Here, the willow monardella population most likely established prior to the stream down-cutting below the terrace, at a time when the stream reach resembled the active braided channels of the other sites. The mature plants are able to expand vegetatively and persist, but seedling establishment seems unlikely. The greater depth to the subsurface water table associated with the stream, and consequent sub-optimal conditions for plant growth and vigor likely account for the reduced size and lower observed vigor of the willowy monardella at this site. The now stable “fossilized”

stream terrace has a surface of embedded cobble, and this surface serves to reduce both weed competition and plant establishment. WMEA 5, in contrast, has a stream that is rapidly deepening to a narrow incised channel, and so it may resemble the assumed early WMEA 4 Control site hydrology. The soil surface at WMEA 5 has a higher proportion of soil and less embedded cobble recorded. The deeper and more complex soil at WMEA 5 allows greater development of competing vegetation, which appears to be detrimental to willowy monardella. Over substantial lengths of time, the continuing erosion at WMEA 5 may bring a cobble substrate to the terrace surface and reduce the attractiveness of the site to invading weed species.

Herbivory reported during this year's monitoring was minor, and this may be a function of the season of the sample. In prior years, plant condition was assessed in mid to late summer, and severe herbivory was commonly observed on the plants. In 2011, the condition assessment was made in late spring, and there was very little herbivory noted. This fact may indicate that plants are able to attain a great deal of seasonal growth, and to devote energy to flowering and seed set before being beset by herbivores. As noted above, some plants scored as weak or even dead in 2010 had recovered and were producing buds and new leaves in 2011, before the presumed herbivory season.

We noted in the previous report (AMEC 2011) that natural levels of herbivory are likely cyclic to periods of fire and drought. However, the natural level of herbivore pressure may have been distorted by the loss of the predator equilibrium through factors related to urbanization in the areas surrounding the Station. Shrub growth and canopy closure that occurs in post-fire succession will impact willowy monardella by providing cover to rabbits and other herbivores, reducing available open seedbed for recruitment, and increasing summer and late-season competition for soil water. The negative association noted in 2010 between severity of herbivory and level of vigor was not a surprising finding, as herbivory and vigor are likely to be correlated, at least late in the growing season. It may indicate that one of the primary determinants of plant condition is the severity of herbivory experienced.

The longevity of willowy monardella is a subject of interest but of little data (Rebman and Dossey 2006). The expansion of the plant via ramets as well as from seed suggests that the species may have long-lived individuals that maintain high vigor due to the growth of new ramets each season. Some of the documented mortality factors such as erosion, shrub overgrowth, and possibly herbivory are not addressed by the experimental treatment of this project. Our data show that the mortality documented in the immediate post-fire succession has tapered off. Surviving plants are disappearing at a relatively low rate, and some balancing recruitment is occurring, if episodically. In 2011, willowy monardella plants are currently showing more evidence of impact from more chaotic disturbance factors (erosion and shrub competition) than from direct NNG competition, although M. viminea plants growing away from shrubs and NNG tended to be larger and more vigorous (Figure 10).

Causes of mortality may be related to herbivory or to erosion, both of which were noted in the sampling over the past three years. The impact of the overgrowth of other shrubs is also noted. In addition, willowy monardella is naturally present in, and appears to prefer, habitat found in frequently disturbed streambeds (Figure 10). The species likely has adaptations to recover and expand its populations after disturbance events. Individual populations appear to be very dynamic, expanding and shrinking in response to rapid environmental changes found in their highly unstable habitats.

Figure 10. *M. viminea* Growing in Cobble Area (left), Under a Shrub (center), and in Dense NNG (right).

Monitoring observation has established that stream erosion is leading to both the loss of, and the recruitment of, willowy monardella plants. The conditions that contribute to erosion also appear to contribute to recruitment, but not necessarily in the same place. Data from WMEA 2, for example, showed the greatest mortality during 2011 (8 plants lost), but only moderate recruitment (three seedlings found).

Herbivory has been documented in past years as strongly reducing willowy monardella plant fitness, and this factor may remove new recruits as well as established plants. Herbivory is a natural factor that has been perturbed in undocumented ways by fire, changes in species composition and land use associated both with a military mission and with urbanization in adjacent areas. The growth of native shrubs, a natural successional factor, may increase shading, but there is no real evidence that shading has a negative effect on the growth and vigor of willowy monardella. There are additional sources of potential mortality including direct losses from exotic grass competition, as well as damage from recreational foot and bicycle traffic.

For 2010, herbivory differed in intensity among sites and treatment groups. During that year, herbivory was most severe at WMEA 1 in the east fork of West Sycamore Canyon; field observations indicate that deer were probably responsible for most of the herbivory. Herbivory had been least severe at WMEA 4 in San Clemente Canyon. There was no obvious difference in herbivory in different treatment types during that year.

The data from 2011 reinforce the recommendations that we have made previously (AMEC 2011) for activities that may be of use in sustaining the population.

1. Encourage the creation of new early successional seedbeds, especially sand bars on meander bends. Such seedbeds are probably created naturally by the cobble sandbanks developed in stream flooding events. As natural cobble sandbanks are likely influenced by heavy storm events that can be exacerbated by the effects of fire and other disturbance, experimental sandbars may need to be created and seeded. Establishment events in such new habitats are likely severely impacted by heavy grass competition, and control of that competition could be targeted in years one and two of a cohort establishment.

   We note that an experiment of this kind has been conducted in nearby Penasquitos Creek in 2004 (Greer and Cheong, 2005). Since 1995 the Friends of Peñasquitos Canyon had documented the loss of several large patches of monardella after large storm events, and noted that effective management for willowy monardella would require managing the changes in hydrology caused by watershed urbanization. A new form of erosion control, called A-Jacks, was suggested for use in Lopez Canyon, a tributary of Penasquitos Canyon. A-Jacks are concrete armor units designed to interlock into a flexible, water-permeable chain. A-Jacks help dissipate water velocity, protecting channel terraces from scouring and erosion. A-Jacks also collect sediment upstream of the plant installation, creating in-stream bars behind the line of structures. This deposition can create additional habitat for willowy monardella. Two such sets of A-Jacks were installed in the canyon, one east of the Camino Santa Fe Bridge up a side canyon of Lopez Canyon and the other well downstream of the bridge to armor an island area that supported three of the then remaining clumps of *M. viminea*. The armoring action was quite effective at one site, and it has successfully protected the populations of *M. viminea* in the stream. There as not, however, been any new establishment of the species into the habitat created upstream of the surviving installation (M. Kelly, pers. comm. June 7, 2011).

2. Protect young seedlings during the critical establishment period. The data indicates mature plants recover naturally from herbivory. This has not been attempted to our knowledge, except where transplantations have occurred. Herbivore exclosures for deer and rabbits would be difficult to maintain, but could provide protection if a portion of a population appears to be vulnerable.

3. Continue with weed control in selected populations. Our data do not show statistically significant effects of this activity, as the variability among treatment sites is great, and the study did not control for any factors besides treatment. Our observations indicate, however, that plants in areas where they are freed of dense growth of NNG tend to be larger and bushier than plants that continually contend with this form of competition. The most compelling site for continued weed management would be in WMEA 5 where NNG competition, a deep soil, and a rapidly incising stream channel combine to restrict the establishment of new willowy monardella plants.

4. As a precaution against future chaotic fire and flood disasters, a small seed collection should be maintained under archival conditions in contract with a University herbarium or botanic garden. Experience should be developed in the species-specific propagation and out-planting protocols for seedlings and cloned ramets. A future fire event has the potential to fully engulf, or at least dramatically reduce, the known populations of willowy monardella on the Station. Therefore, the future of this species will depend on the ability to successfully reestablish plants along prepared stream channels. Seed in a highly reduced population may be limited, as we noted a high level of predation on seeds late in the season (November 2009) on at least some populations.

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APPENDIX A

MAPS AND PHOTOS OF WILLOWY MONARDELLA ENHANCEMENT AREAS

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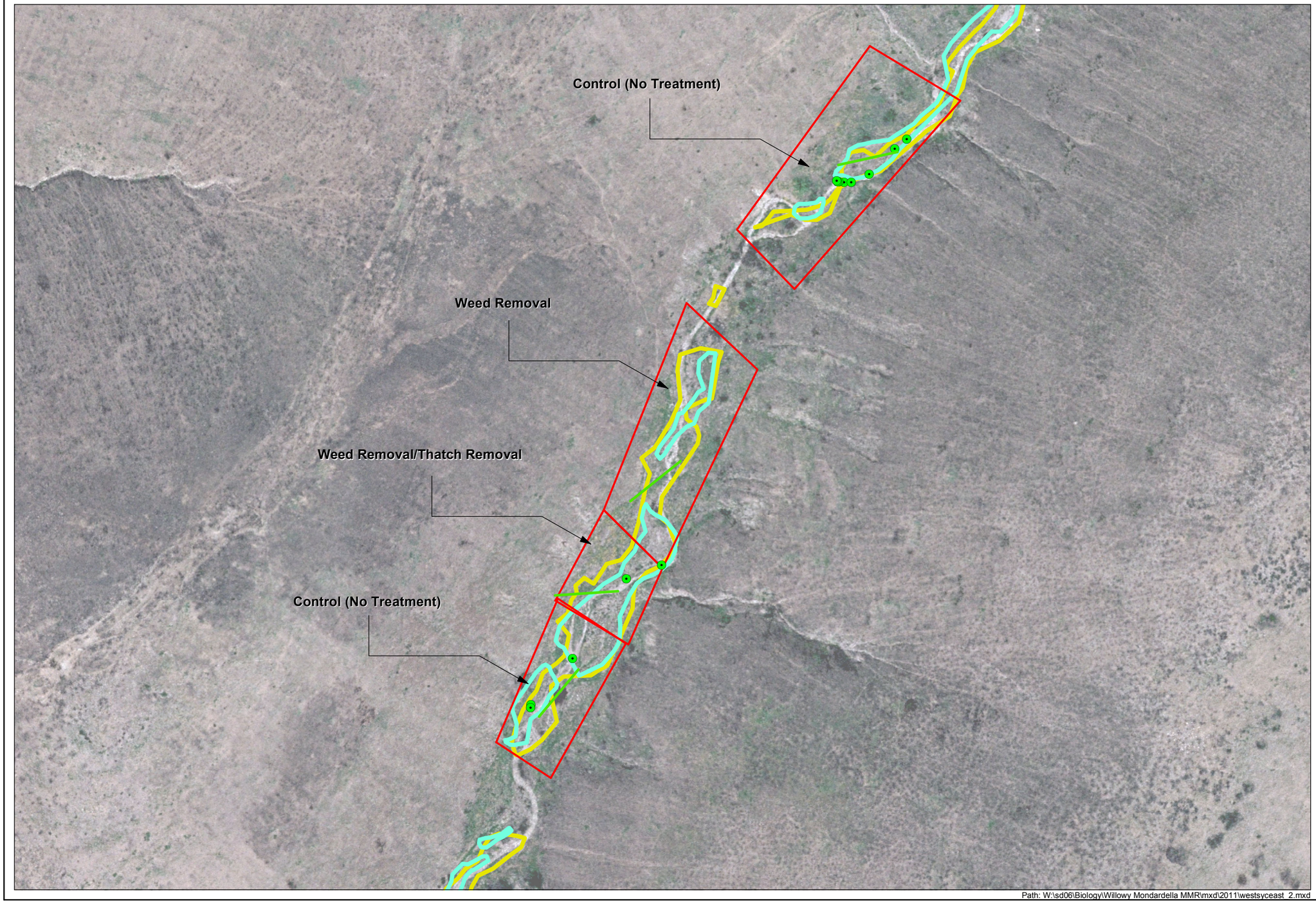

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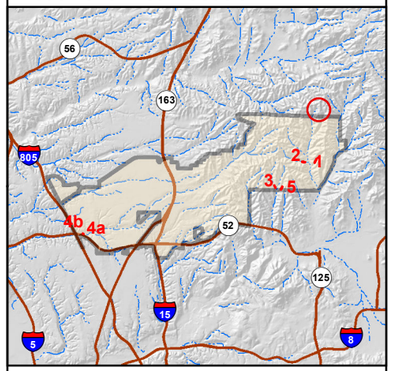
Legend

- 2011 Transect Locations
- 2011 Willowy Monardella Seedlings
- Willowy Monardella (2006)
- Willowy Monardella (2002)
- Treatment Area

Treatment Area Location



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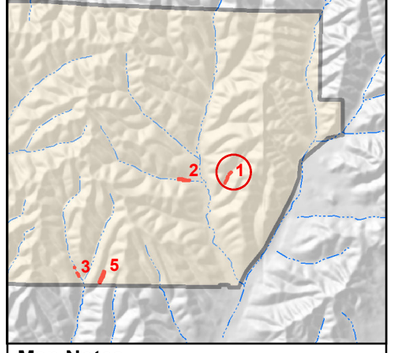

Map Notes

Data Source:
MCAS Miramar - Air Station Boundary,
2004 3-band Color Image
AMEC - Treatment Areas

Projection: Stateplane, California 406
NAD 83, Feet

Date: 7/7/2011

1 inch = 100 feet

0 50 100 Feet

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Willowy Monardella Enhancement Area 1
West Sycamore Canyon East
Marine Corps Air Station Miramar

FIGURE
A-1

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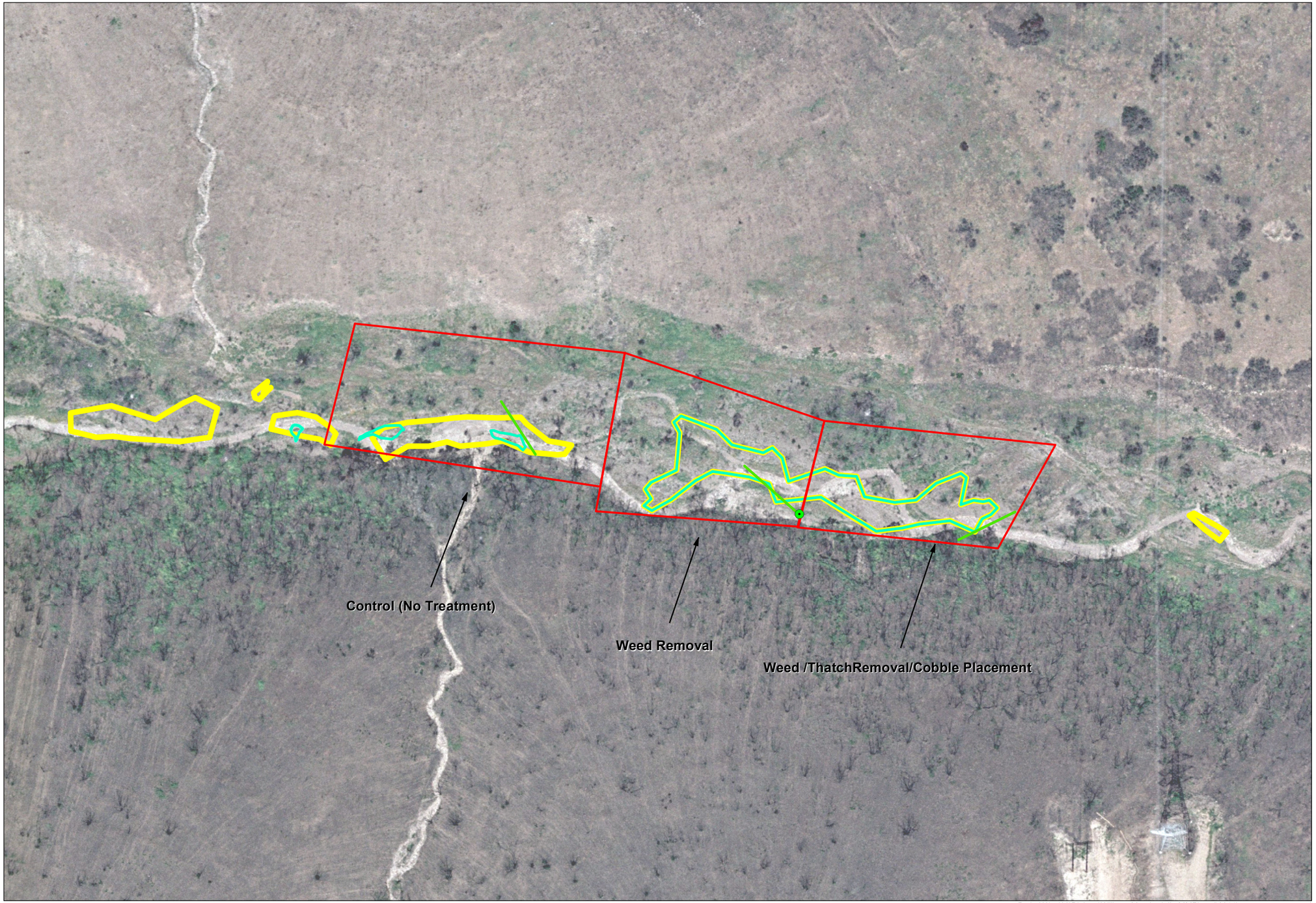
Figure A2a. WMEA 1 West Sycamore Canyon East Fork. Channel and vegetation. Bright green plants are willowy monardella.

Figure A2b. WMEA 1. Transect in Control A. Plant in foreground is willowy monardella.

Figure A2c. WMEA 1. Transect Control B. Plants at channel edge of willowy monardella. Red flag indicates location of a seedling.

Figure A2d. WMEA 1. Transect W. Plant in channel is willowy monardella.

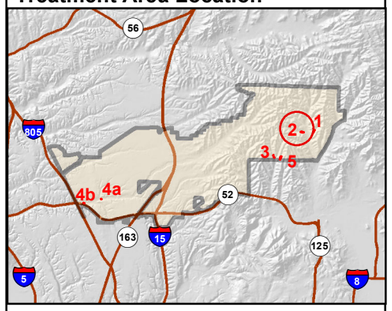
Figure A2e. WMEA 1. Transect WT. Green plants in channel are willowy monardella.



Legend

- 2011 Transect Locations
- 2011 Willowy Monardella Seedlings
- Willowy Monardella (2002)
- Willowy Monardella (2006)
- Treatment Area

Treatment Area Location



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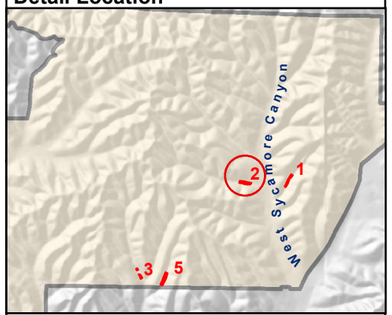

Map Notes

Data Source:
MCAS Miramar - Air Station Boundary,
2004 3-band Color Image
AMEC - Treatment Areas

Projection: Stateplane, California 406
NAD 83, Feet
Date: 7/7/2011

1 inch = 100 feet

0 50 100 Feet

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Willowy Monardella Enhancement Area 2
West Sycamore Canyon West
Marine Corps Air Station Miramar

FIGURE
A-3

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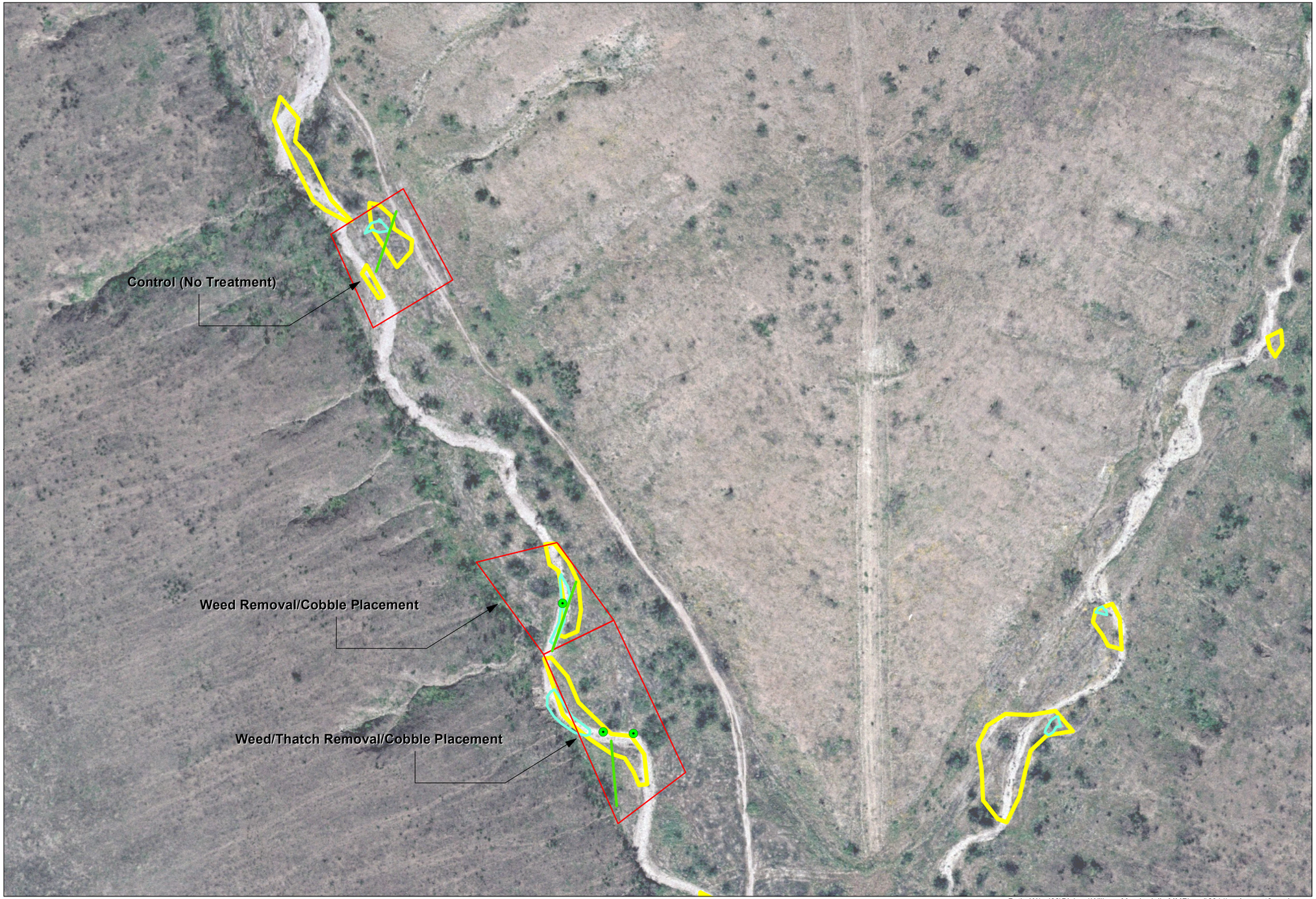
Figure A4a. WMEA 2. West Sycamore Canyon, East fork. Channel and terrace. Bright green plants on terrace are willowy monardella.

Figure A4b. WMEA 2. Transect C. Bright green plants in channel are willowy monardella.

Figure A4c. WMEA 2. Transect W. Transect spans two channels and a terrace.

Figure A4d. WMEA 2. Transect WT.



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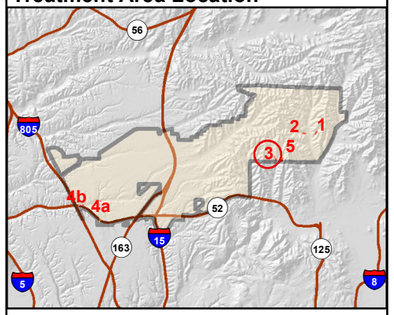
Legend

- 2011 Transect Locations
- 2011 Willowy Monardella Seedlings
- Treatment Area
- Willowy Monardella (2006)
- Willowy Monardella (2002)

Treatment Area Location



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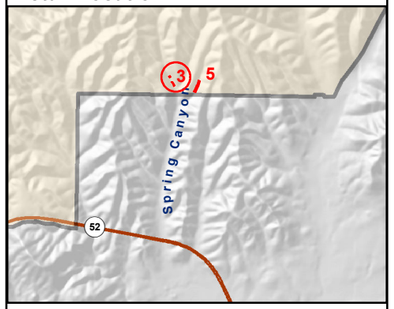

Map Notes

Data Source:
MCAS Miramar - Air Station Boundary, 2004 3-band Color Image
AMEC - Treatment Areas

Projection: Stateplane, California 406 NAD 83, Feet
Date: 7/7/2011

1 inch = 100 feet

0 50 100 Feet

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Willowy Monardella Enhancement Area 3
Spring Canyon West
Marine Corps Air Station Miramar

FIGURE
A-5

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Figure A6a. WMEA 3. Spring Canyon West fork. Green plant in channel is willowy monardella. Note cut bank on the left side of the stream.

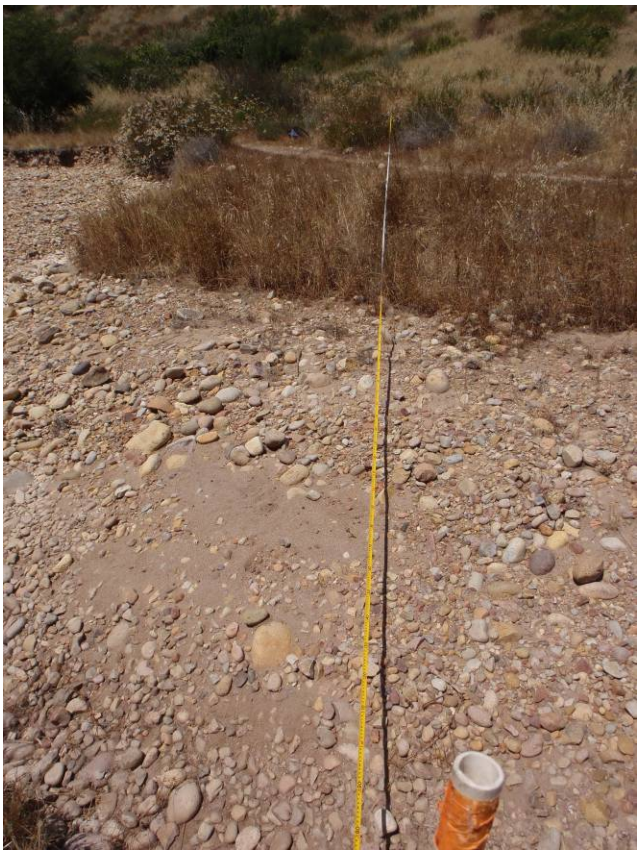


Figure A6b. WMEA 3. Transect C. Transect crosses channel, terrace, and trail.

Figure A6c. WMEA 3. Transect W. Bright green plants are willowy monardella.

Figure A6d. WMEA 3. Transect WT. Transect crosses channel at far end.

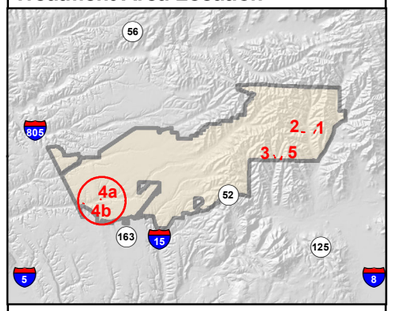
Treatment Area 4a

Treatment Area 4b

Legend

- 2011 Transect Locations
- 2011 Willowy Monardella Seedlings
- Willowy Monardella (2006)
- Willowy Monardella (2002)
- Treatment Area

Treatment Area Location



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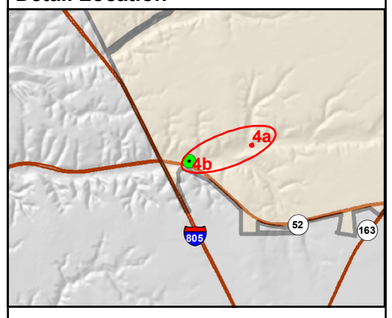

Map Notes

Data Source:
MCAS Miramar - Air Station Boundary,
2004 3-band Color Image
AMEC - Treatment Areas

Projection: Stateplane, California 406
NAD 83, Feet

Date: 7/7/2011

1 inch = 100 feet

0 50 100 Feet

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Willowy Monardella Enhancement Areas 4a, 4b
Lower San Clemente Canyon
Marine Corps Air Station Miramar

FIGURE
A-7

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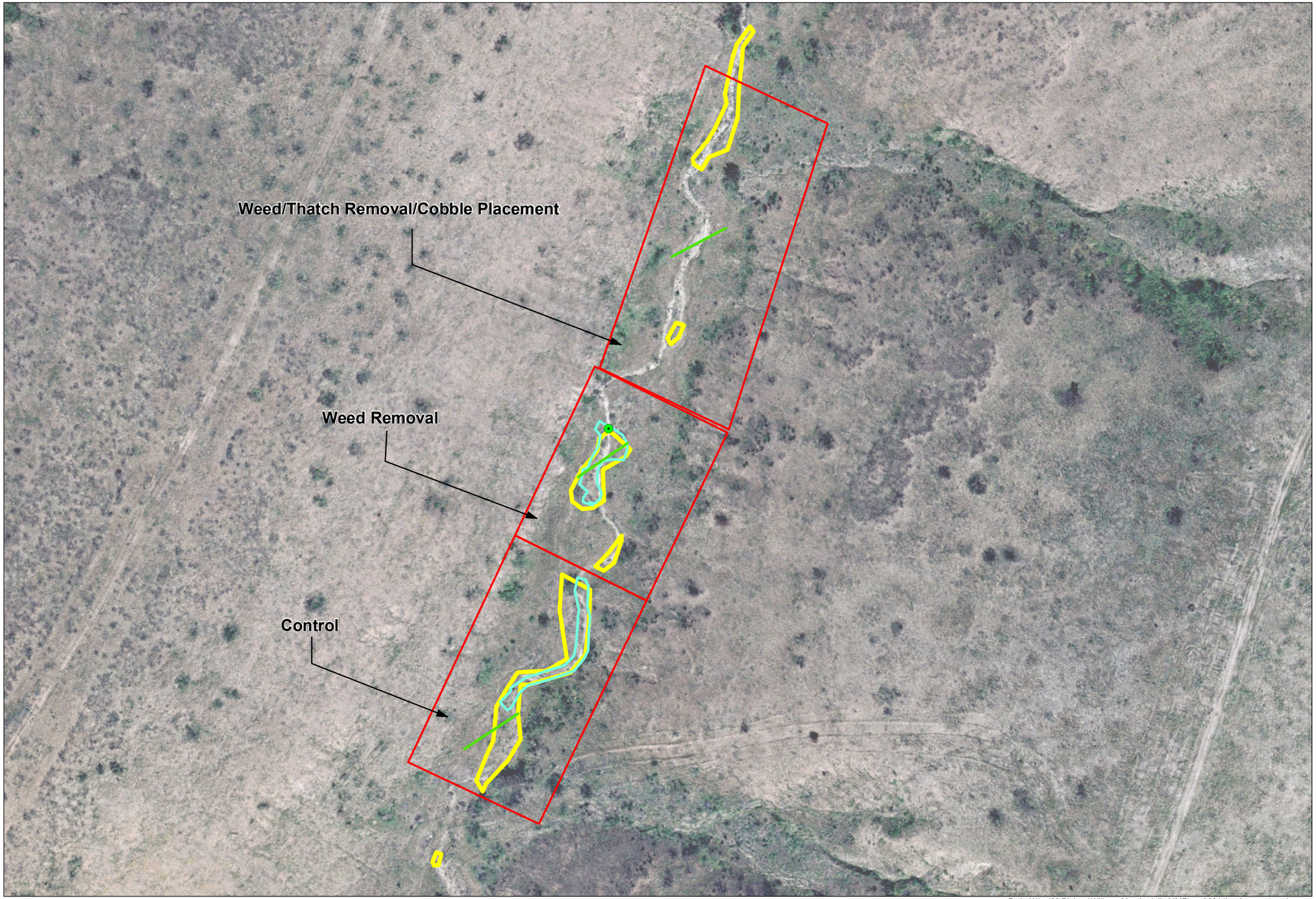
Figure A8a. WMEA 4a. San Clemente Canyon, control area. Site is on a terrace elevated above the stream channel. Willowy monardella plants are associated with buckwheat and coyote broom.

Figure A8b. WMEA 4a. Transect C.

Figure A8c. WMEA 4b. San Clemente Canyon. Treatment area. Treatment was conducted around willowy monardella plants only, not on entire site.

Figure A8d. WMEA 4b. Transect WT. Treatment was conducted around willowy monardella plants only, not on the entire site.



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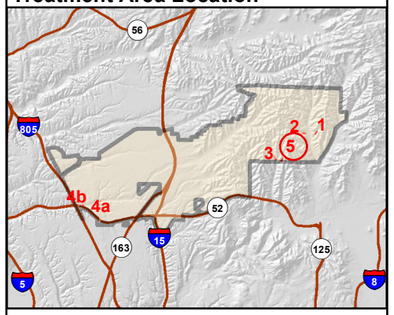
Legend

- 2011 Transect Locations
- 2011 Willowy Monardella Seedlings
- Willowy Monardella (2006)
- Willowy Monardella (2002)
- Treatment Area

Treatment Area Location



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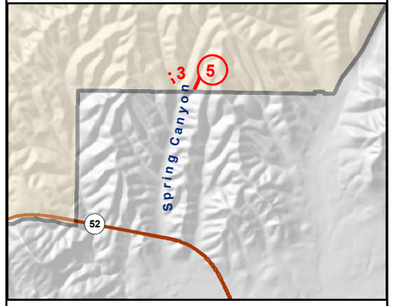

Map Notes

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2004 3-band Color Image
AMEC - Treatment Areas

Projection: Stateplane, California 406
NAD 83, Feet
Date: 7/7/2011

1 inch = 100 feet

0 50 100 Feet

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Willowy Monardella Enhancement Area 5
Spring Canyon East
Marine Corps Air Station Miramar

FIGURE
A-9

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Figure A10a. WMEA 5. Transect C. Note height of non-native grasses.

Figure A10b. WMEA 5. Transect W.

Figure A10c. WMEA 5. Transect WT. Bright green plant in middle ground is willowy monardella.

Figure A10d. WMEA 5 C. Willowy monardella in dense NNG. Plant is more diffuse and less shrubby than plants not associated with dense grass.

APPENDIX B

SPECIES RICHNESS IN ALL WMEA SITES

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*species in black text were added summer 2008
*species in blue text were added spring 2009
*species in red text were added spring 2010

Species List - Enhancement Area 1 - West Sycamore Canyon East

Scientific Name	Common Name	Status
Native Species		
Acourtia microcephala	sacapellote	
Amsinckia menziesii var intermedia	rancher's fiddleneck	
Antirrhinum nutallianum	Nuttal snapdragon	
Artemisia californica	coastal sagebrush	
Baccharis sarothroides	broom baccharis	
Bromus carinatus	California brome	
Calandrinia breweri	brewer calandrinia	
Calandrinia ciliata	red maids	
Calystegia macrostegia ssp tenuifolia	San Diego morning Glory	
Castilleja exerta ssp *exerta*	owl's clover	
Caulanthus heterophyllus	slender-pod jewel flower	
Ceanothus tomentosus	Ramona lilac	
Cercocarpus minutiflorus	mountain mahogany	
Clarkia purpurea ssp *quadrivulnera*	wine cups	
Claytonia parviflora	miner's lettuce	
Claytonia perfoliata	miner's lettuce	
Clematis pauciflora	clematis	
Collinsia heterophylla	Chinese houses	
Cordylanthus rigidus ssp. setigerus	dark-tip bird's beak	
Crassula aquatica	common pygmy weed	
Croton setigerus *(Eremocarpus setigerus)*	dove weed	
Cryptantha intermedia	crypantha	
Deinandra fasiculata	tarweed	

Species List - Enhancement Area 1 - West Sycamore Canyon East

Scientific Name	Common Name	Status
Delphinium parryi ssp *parryi*	blue larspur	
Descurania pinnata	tansy mustard	
Dichelostemma capitatum sspp capitatum	blue dicks	
Dodecatheon clevelandii	shotting star	
Emmenanthe penduliflora var penduliflora	whispering bells	
Eriodictyon crassifolium var crassifolium	flat-leaf yerba santa	
Eriogonum fasciculatum	California buckwheat	
Eriophyllum confertiflorum var confertiflorum	golden yarrow	
Eschscholzia californica	California poppy	
Eucryptha chrysanthemifolia	common eucrypta	
Ferocactus viridescens var viridescens	San Diego barrel cactus	CNPS List 2.1
Filago californica	California filago	
Galium nuttallii	San Diego bedstraw	
Helianthemum scoparium	yellow rock-rose	
Hesperoyucca whipplei	chaparral yucca	
Heteromeles arbutifolia	toyon	
Isocoma menziesii	goldenbush	
Jepsonia parryi	coast jepsonia	
Lathyrus vestitus	wild pea	
Lepidium lasiocarpum	peppergrass	
Lepidium nitidum	peppergrass	
Linanthus (Leptosiphon) parviflorus	coast baby star	
Linaria candensis	blue toadflax	
Lonicera subspicata	southern honeysuckle	
Lupinus bicolor	dove lupine	
Lotus scoparius	deer weed	
Leymus condensatus	giant rye grass	

Species List - Enhancement Area 1 - West Sycamore Canyon East

Scientific Name	Common Name	Status
Malacothamnus fasciculatus	bushmallow	
Malosma laurina	laurel sumac	
Marah macrocarpus	wild cucumer	
Melica imperfecta	coast melic	
Micropus californicus	slender cottonweed	
Mimulus aurantiacus var aurantiacus	bush monkeyflower	
Mimulus guttatus	seep monkeyflower	
Mirabilis laevis	wishbone bush	
Monardella viminea	willowy monardella	CNPS List 1B.1; CA State & Federal Listed Endangered
Opuntia littoralis	coast prickly-pear	
Oxalis albicans ssp Californica	California wood sorrel	
Pellaea mucronata var mucronata	bird's foot fern	
Pentagramma viscosa	silverback fern	
Phacelia distans	common phacelia	
Plagiobothrys nothofulvus	popcorn flower	
Pterostegia drymariodes	granny's hairnet	
Prunus ilicifolia	holly-leaf cherry	
Quercus berberidifolia	scrub oak	
Rhamnus crocea	spiny redberry	
Rhus ovata	sugar bush	
Sanicula arguta	sharp-tooth sanicle	
Selaginella bigelovii	spike moss	
Sidalcea malvaeflora ssp sparsiflora	checkerbloom	
Solanum parishii	Parish nightshade	
Salvia apiana	white sage	
Salvia mellifera	black sage	
Stephanomeria exigua	small wreath-plant	

Species List - Enhancement Area 1 - West Sycamore Canyon East

Scientific Name	Common Name	Status
Thysanocarpus laciniatus	fringe-pod	
Toxicodendron diversilobum	poison oak	
Trilfolium willdenovii	tomcat clover	
Viola pedunculata	johnny jump-up	
Xylococcus bicolor	mission manzanita	
Non-Native Species		
Avena barbata	wild oat	Cal-IPC moderate
Brassica nigra	black mustard	
Bromus diandrus	ripgut brome	Cal-IPC moderate
Bromus hordeaceus	soft chess	Cal-IPC limited
Bromus madritensis ssp. Rubens	red foxtail brome	Cal-IPC high
Centaurea melitensis	tocalote	Cal-IPC moderate
Erodium botrys	long-beaked filaree	
Erodium cicutarium	red stem filaree	Cal-IPC limited
Erodium moschatum	white stem filaree	
Hedypnois cretica	crete weed	
Hirschfeldia incana	short-pod mustard	Cal-IPC moderate
Hypochaeris glabra	cat's ear	Cal-IPC limited
Reseda luteola	wild mignonette	
Silene gallica	windmill pink	
Senecio vulgaris	groundsel	
Stellaria media	common chickweed	
Veronica anagallis-aquatica	water speedwell	
Vulpia myros	rat's tail	Cal-IPC moderate
Vulpia bromoides	six weeks fescue	

*species in black text were added summer 2008
*species in blue text were added spring 2009
*species in red text were added spring 2010

Species List - Enhancement Area 2 - West Sycamore Canyon West

Scientific Name	Common Name	Status
Native Species		
Acourtia microcephala	sacapellote	
Adiantium jordanii	maidenhair Fern	
Allium praecox	red-skinned onion	
Amsinckia menziesii var intermedia	rancher's fiddleneck	
Artemisia californica	coastal Sagebrush	
Baccharis sarothroides	broom Baccharis	
Bloomeria crocea ssp crocea	golden Stars	
Bromus carinatus	California brome	
Calystegia macrostegia ssp *tenuifolia*	San Diego morning Glory	
Castilleja exerta ssp *exerta*	owl's clover	
Caulanthus heterophyllus	slender-pod jewel flower	
Cercocarpus minutiflorus	mountain mahogany	
Chenopodium californicum	California goosefoot	
Clarkia epilobiodes	canyon clarkia	
Clarkia purpurea ssp *quadrivulnera*	wine cups	
Claytonia parviflora	miner's lettuce	
Claytonia perfoliata	miner's lettuce	
Clematis pauciflora	clematis	
Collinsia heterophylla	Chinese houses	
Crassula aquatica	common pygmy weed	
Croton setigerus *(Eremocarpus setigerus)*	dove weed	
Cryptantha intermedia	crypantha	

Species List - Enhancement Area 2 - West Sycamore Canyon West

Scientific Name	Common Name	Status
Deinandra fasiculata	tarweed	
Dicentra chrysantha	golden Ear-Drops	
Dichelostemma capitatum sspp capitatum	blue dicks	
Epilobium canum	California Fushia	
Eriodictyon crassifolium var crassifolium	flat-leaf yerba santa	
Eriogonum fasciculatum	California Buckwheat	
Eriophyllum confertiflorum var confertiflorum	golden yarrow	
Eschscholzia caespitosa	tufted-gold poppy	
Eschscholzia californica	California poppy	
Eucryptha chrysanthemifolia	common eucrypta	
Ferocactus viridescens var viridescens	San Diego barrel cactus	CNPS List 2.1
Filago californica	California filago	
Galium aparine	common bedstraw	
Galium nuttallii	San Diego bedstraw	
Geranium californicum	California geranium	
Gnaphalium californicum	California everlasting	
Gnaphalium canescens ssp microcephalum	white everlasting	
Gnaphalium stramineum	cotton-batting plant	
Helianthemum scoparium	yellow rock-rose	
Hesperoyucca whipplei	chaparral Yucca	
Heteromeles arbutifolia	toyon	
Lathyrus vestitus	wild pea	
Lepidium lasiocarpum	peppergrass	
Lepidium nitidum	peppergrass	
Linanthus (Leptosiphon) parviflorus	coast baby star	
Linaria candensis	blue toadflax	
Lonicera subspicata	southern Honeysuckle	
Lotus scoparius	deer Weed	

Species List - Enhancement Area 2 - West Sycamore Canyon West

Scientific Name	Common Name	Status
Lupinus bicolor	dove lupine	
Lupinus truncatus	collar lupine	
Malacothamnus fasciculatus	bushmallow	
Malosma laurina	laurel sumac	
Marah macrocarpus	wild cucumer	
Melica imperfecta	coast melic	
Mimulus aurantiacus var aurantiacus	bush monkeyflower	
Mimulus guttatus	seep monkeyflower	
Mirabilis laevis	wishbone bush	
Monardella viminea	willowy monardella	CNPS List 1B.1; CA State & Federal Listed Endangered
Opuntia littoralis	coast prickly-pear	
Oxalis albicans ssp. Californica	California wood sorrel	
Pellaea mucronata	bird's foot fern	
Pentagramma viscosa	silverback fern	
Phacelia distans	common phacelia	
Pholistoma auritum var auritum	fiesta flower	
Plagiobothrys sp	popcorn flower	
Prunus ilicifolia	holly-leaf cherry	
Pterostegia drymariodes	granny's hairnet	
Quercus berberidifolia	scrub oak	
Rhamnus crocea	spiny redberry	
Rhus integrifolia	lemonade berry	
Rumex salicifolius	willow dock	
Salvia apiana	white sage	
Salvia mellifera	black sage	
Selaginella bigelovii	spike moss	
Sidalcea malvaeflora ssp sparsiflora	checkerbloom	
Sisyrinchium bellum	blue-eyed grass	

Species List - Enhancement Area 2 - West Sycamore Canyon West

Scientific Name	Common Name	Status
Solanum parishii	Parish nightshade	
Stephanomeria exigua	small wreath-plant	
Thalictrum fendleri	meadow rue	
Thysanocarpus laciniatus	fringe-pod	
Toxicodendron diversilobum	poison oak	
Trilfolium willdenovii	tomcat clover	
Uropappus lindleyi	silver puffs	

Non-Native Species

Avena barbata	wild oat	Cal-IPC moderate
Brassica nigra	black mustard	Cal-IPC moderate
Bromus diandrus	ripgut brome	Cal-IPC moderate
Bromus hordeaceus	soft chess	Cal-IPC limited
Bromus madritensis ssp. Rubens	red foxtail brome	Cal-IPC high
Erodium botrys	long-beaked filaree	
Erodium cicutarium	red stem filaree	Cal-IPC limited
Erodium moschatum	white stem filaree	
Euphorbia peplus	petty spurge	
Hirschfeldia incana	short-pod mustard	Cal-IPC moderate
Hypochaeris glabra	cat's ear	Cal-IPC limited
Lolium multiflorum	Italian ryegrass	
Plantago major	common plantain	
Reseda luteola	wild mignonette	
Senecio vulgaris	*groundsel*	
Silene gallica	*windmill pink*	
Stellaria media	*common chickweed*	

Species List - Enhancement Area 2 - West Sycamore Canyon West

Scientific Name	Common Name	Status
Vulpia myros	*rat's tail*	Cal-IPC moderate
Vulpia bromoides	six weeks fescue	

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*species in black text were added summer 2008
*species in blue text were added spring 2009
*species in red text were added spring 2010

Species List - Enhancement Area 3 - Spring Canyon West

Scientific Name	Common Name	Status
Native Species		
Amsinckia menziesii var intermedia	rancher's fiddleneck	
Adenostoma fasciculatum	chamise	
Ambrosia psilostachya	western ragweed	
Artemisia californica	coastal sagebrush	
Baccharis sarothroides	broom baccharis	
Brickellia californica	California brickelbush	
Bromus carinatus	California brome	
Calandrinia ciliata	red maids	
Calystegia macrostegia ssp. tenuifolia	San Diego morning glory	
Castilleja exerta ssp *exerta*	owl's clover	
Ceanothus tomentosus	Ramona lilac	
Cercocarpus minutiflorus	mountain mahogany	
Clarkia epilobiodes	canyon clarkia	
Claytonia parviflora	miner's lettuce	
Claytonia perfoliata	miner's lettuce	
Clematis pauciflora	clematis	
Collinsia heterophylla	Chinese houses	
Cordylanthus rigidus ssp. setigerus	dark-tip bird's beak	
Crassula aquatica	common pygmy weed	
Croton setigerus *(Eremocarpus setigerus)*	dove weed	
Deinandra fasciculata	tarweed	

Species List - Enhancement Area 3 - Spring Canyon West

Scientific Name	Common Name	Status
Dichelostemma capitatum sspp capitatum	blue dicks	
Erigeron foliosus var. foliosus	fleabane daisy	
Eriogonum fasciculatum	California buckwheat	
Eriophyllum confertiflorum var confertiflorum	golden yarrow	
Eschscholzia caespitosa	tufted-gold poppy	
Eschscholzia californica	California poppy	
Eucryptha chrysanthemifolia	common eucrypta	
Ferocactus viridescens var viridescens	San Diego barrel cactus	CNPS List 2.1
Filago californica	California filago	
Galium nuttallii	San Diego bedstraw	
Galium stellatum	star-flowered bedstraw	
Gnaphalium californicum	California everlasting	
Gnaphalium canescens ssp microcephalum	white everlasting	
Gnaphalium palustre	cudweed	
Hesperoyucca whipplei	chaparral yucca	
Heteromeles arbutifolia	toyon	
Heterotheca grandiflora	telegraph weed	
Juncus bufonius	toad rush	
Lathyrus vestitus	wild pea	
Lepidium lasiocarpum	peppergrass	
Lessingia filaginifolia var filaginifolia	California aster	
Lonicera subspicata	southern honeysuckle	
Lotus scoparius	deer weed	
Lupinus bicolor	dove lupine	
Lupinus hirsutissimus	stinging lupine	
Lupinus truncatus	collar lupine	

Species List - Enhancement Area 3 - Spring Canyon West

Scientific Name	Common Name	Status
Malacothamnus fasciculatus	bushmallow	
Malosma laurina	laurel sumac	
Marah macrocarpus	wild cucumer	
Melica imperfecta	coast melic	
Mirabilis laevis	wishbone bush	
Mimulus aurantiacus var aurantiacus	bush monkeyflower	
Monardella viminea	willowy monardella	CNPS List 1B.1; CA State & Federal Listed Endangered
Nassella pulchra	purple needlegrass	
Opuntia littoralis	coast prickly-pear	
Phacelia distans	common phacelia	
Pholistoma auritum var auritum	fiesta flower	
Prunus ilicifolia	holly-leaf cherry	
Quercus berberidifolia	scrub oak	
Rhamnus crocea	spiny redberry	
Ribes speciosum	fushia-flower gooseberry	
Rumex salicifolius	willow dock	
Salvia apiana	white sage	
Salvia mellifera	black sage	
Selaginella bigelovii	spike moss	
Sidalcea malvaeflora ssp sparsiflora	checkerbloom	
Solanum parishii	Parish nightshade	
Stephanomeria exigua	small wreath-plant	
Toxicodendron diversilobum	poison oak	
Uropappus lindleyi	silver puffs	
Viola pedunculata	johnny jump-up	
Xylococcus bicolor	mission manzanita	

Species List - Enhancement Area 3 - Spring Canyon West

Scientific Name	Common Name	Status
Non-Native Species		
Avena barbata	wild oat	Cal-IPC moderate
Bromus diandrus	ripgut brome	Cal-IPC moderate
Bromus hordeaceus	soft chess	Cal-IPC limited
Bromus madritensis ssp. Rubens	red foxtail brome	Cal-IPC high
Centaurea melitensis	tocalote	Cal-IPC moderate
Conyza canadensis	horseweed	
Cynodon dactylon	Bermuda grass	
Erodium botrys	long-beaked filaree	
Erodium cicutarium	red stem filaree	Cal-IPC limited
Erodium moschatum	white stem filaree	
Euphorbia peplus	petty spurge	
Hypochaeris glabra	cat's ear	Cal-IPC limited
Lolium multiflorum	Italian ryegrass	
Reseda luteola	wild mignonette	
Rumex crispus	curly dock	
Silene gallica	windmill pink	
Spergularia bocconii	sand spurrey	
Stellaria media	common chickweed	
Vulpia myros	rat's tail	Cal-IPC moderate
Vulpia bromoides	six weeks fescue	

*species in blue text were added spring 2009
*species in red text were added spring 2010

Species List - Enhancement Area 4 : San Clemente Canyon

Scientific Name	Common Name	Status
Native Species		
Ambrosia acanthicarpa	bur-sage	
Amsinckia menziesii var intermedia	rancher's fiddleneck	
Artemisia californica	coastal sagebrush	
Artemisia palmeri	Palmer sagewort	
Baccharis piluaris	coyote bush	
Baccharis salicfolia	mule-fat	
Baccharis sarothroides	broom baccharis	
Bromus carinatus	California brome	
Calystegia macrostegia ssp *tenuifolia*	San Diego morning Glory	
Claytonia perfoliata	miner's lettuce	
Corethrogyne filafinifolia	California aster	
Crassula aquatica	common pygmy weed	
Cuscuta californica	dodder	
Dichelostemma capitatum sspp capitatum	blue dicks	
Eriogonum fasciculatum	California buckwheat	
Eschscholzia californica	California poppy	
Galium angustifolium ssp. angustifolium	narrow-leaved bedstraw	
Galium nuttallii	San Diego bedstraw	
Heteromeles arbutifolia	toyon	
Heterotheca grandiflora	telegraph weed	
Isocoma menziesii	goldenbush	
Lonicera subspicata	southern honeysuckle	
Lotus scoparius	deer weed	
Lupinus bicolor	dove lupine	
Lupinus truncatus	collar lupine	
Monardella viminea	willowy monardella	CNPS List 1B.1; CA State & Federal Listed Endangered

Species List - Enhancement Area 4 : San Clemente Canyon

Scientific Name	Common Name	Status
Opuntia littoralis	coastal prickly pear	
Platanus racemosa	California sycamore	
Prunus ilicifolia	holly-leaf cherry	
Quercus agrifolia	coast live oak	
Salix lasiolepis	arroyo willow	
Salvia apiana	white sage	
Salvia mellifera	black sage	
Solanum parishii	Parish's nightshade	
Toxicodendron diversilobum	poison oak	

Non-Native Species

Asphodelus fistulosus	onion weed	Cal-IPC moderate
Avena barbata	slender wild oat	Cal-IPC
Avena fatua	wild oat	Cal-IPC
Brassica nigra	black mustard	Cal-IPC moderate
Bromus diandrus	ripgut brome	Cal-IPC moderate
Bromus hordeaceus	soft chess	Cal-IPC limited
Bromus madritensis ssp. Rubens	red foxtail brome	Cal-IPC high
Carduus pycnocephalus	Italian thistle	(Cal-IPC moderate and California Department of Food and Ag Noxious weed list C)
Erodium botrys	long-beaked filaree	
Erodium cicutarium	red stem filaree	Cal-IPC limited
Erodium moschatum	white stem filaree	
Foeniculum vulgare	fennel	Cal-IPC high
Hirschfeldia incana	short-pod mustard	Cal-IPC moderate
Latuca serriola	prickly lettuce	
Lolium multiflorum	Italian ryegrass	Cal-IPC moderate
Plantago lanceolata	English plantain	Cal-IPC limited
Rumex crispus	dock	Cal-IPC limited
Senecio vulgaris	groundsel	

Species List - Enhancement Area 4 : San Clemente Canyon

Scientific Name	Common Name	Status
Silene gallica	windmill pink	
Trifolium hirtum	rose clover	Cal-IPC moderate
Vulpia myros	rat's tail	Cal-IPC moderate
Vulpia bromoides	six weeks fescue	

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Species List - Enhancement Area 5 -Spring Canyon East

Native Species

Acourtia microcephala	sacapellote	
Amsinckia menziesii var intermedia	rancher's fiddleneck	
Adenostoma fasciculatum	chamise	
Artemisia californica	coastal sagebrush	
Artemisia palmeri	Palmer's sagewort	
Baccharis sarothroides	broom baccharis	
Bloomeria crocea ssp *crocea*	golden Stars	
Bromus carinatus	California brome	
Calandrinia ciliata	red maids	
Calystegia macrostegia ssp *tenuifolia*	San Diego morning Glory	
Castilleja exerta ssp *exerta*	owl's clover	
Cercocarpus minutiflorus	mountain mahogar	
Chenopodium californicum	California goosefoot	
Clarkia epilobiodes	canyon clarkia	
Clarkia purpurea ssp *quadrivulnera*	wine cups	
Claytonia parviflora	miner's lettuce	
Claytonia perfoliata	miner's lettuce	
Clematis pauciflora	clematis	
Collinsia heterophylla	Chinese houses	
Crassula aquatica	common pygmy weed	
Cuscuta californica	dodder	
Deinandra fasiculata	tarweed	
Dichelostemma capitatum sspp capitatum	blue dicks	
Dodecatheon clevelandii	shotting star	
Dudleya pulverulenta	chalk dudleya	
Epilobium canum	california fushia	
Erigeron foliosus var. foliosus	fleabane daisy	
Eriogonum fasciculatum	California buckwhe	
Eriophyllum confertiflorum var confertiflorum	golden yarrow	
Eschscholzia caespitosa	tufted-gold poppy	
Eschscholzia californica	California poppy	
Eucryptha chrysanthemifolia	common eucrypta	
Ferocactus viridescens var viridescens	San Diego barrel cactus	CNPS List 2.1
Filago californica	California filago	
Galium angustifolium ssp. angustifolium	narrow-leaved bedstraw	
Galium nuttallii	San Diego bedstraw	
Geranium californicum	California geranium	
Gnaphalium canescens ssp microcephalum	white everlasting	
Hesperoyucca whipplei	chaparral yucca	
Heteromeles arbutifolia	toyon	
Isocoma menziesii	goldenbush	

Species List - Enhancement Area 5 -Spring Canyon East

Native Species

Lathyrus vestitus	wild pea	
Lepidium lasiocarpum	peppergrass	
Lessingia filaginifolia var filaginifolia	California aster	
Linaria candensis	blue toadflax	
Lonicera subspicata	southern honeysuckle	
Lotus scoparius	deer weed	
Lupinus bicolor	dove lupine	
Lupinus hirsutissimus	stinging lupine	
Malacothamnus fasciculatus	bushmallow	
Malosma laurina	laurel sumac	
Marah macrocarpus	wild cucumer	
Melica imperfecta	coast melic	
Mimulus aurantiacus var aurantiacus	bush monkeyflower	
Mirabilis laevis	wishbone bush	
Monardella viminea	willowy monardella	CNPS List 1B.1; CA State & Federal Listed Endangered
Opuntia ficus -indica	mission cactus	
Opuntia littoralis	coast prickly-pear	
Oxalis albicans ssp. Californica	California wood sorrel	
Pellaea mucronata var mucronata	bird's foot fern	
Pentagramma viscosa	silverback fern	
Phacelia distans	common phacelia	
Pholistoma auritum var auritum	fiesta flower	
Plagiobothrys nothofulvus	popcorn flower	
Platystemon californicus	cream cups	
Pterostegia drymariodes	granny's hairnet	
Prunus ilicifolia	holly-leaf cherry	
Quercus berberidifolia	scrub oak	
Rhamnus crocea	redberry	
Ribes indecorum	white-flower currar	
Ribes speciosum	fushia-flower gooseberry	
Salvia apiana	white sage	
Salvia columbariae	chia	
Sambucus mexicana	blue elderberry	
Sanicula arguta	sharp-tooth sanicle	
Selaginella bigelovii	spike moss	
Sidalcea malvaeflora ssp sparsiflora	checkerbloom	
Solanum parishii	Parish nightshade	
Silene laciniata	indian pink	
Thysanocarpus laciniatus	fringe-pod	
Toxicodendron diversilobum	poison oak	
Trilfolium willdenovii	tomcat clover	

Species List - Enhancement Area 5 -Spring Canyon East

Native Species

Uropappus lindleyi	silver puffs	
Viola pedunculata	johnny jump-up	
Xylococcus bicolor	mission manzanita	

Non-Native Species

Anagallis arvensis	scarlet pimpernel	Cal-IPC moderate
Avena barbata	wild oat	Cal-IPC moderate
Brassica nigra	black mustard	
Bromus diandrus	ripgut brome	Cal-IPC moderate
Bromus hordeaceus	soft chess	Cal-IPC limited
Bromus madritensis ssp. Rubens	red foxtail brome	Cal-IPC high
Centaurea melitensis	tocalote	Cal-IPC moderate
Conyza canadensis	horseweed	
Erodium botrys	long-beaked filaree	
Erodium cicutarium	red stem filaree	Cal-IPC limited
Erodium moschatum	white stem filaree	
Latuca serriola	prickly lettuce	
Lolium multiflorum	Italian ryegrass	
Lythrum hyssopifolium	grass poly	
Medicago polymorpha	California burclover	
Melilotus alba	white sweetclover	
Oxalis pes-caprae	Bermuda buttercup	
Polypogon monspeliensis	annual beard grass	
Raphanus sativus	wild radish	
Reseda luteola	wild mignonette	
Senecio vulgaris	groundsel	
Silene gallica	windmill pink	
Stellaria media	common chickweed	
Trifolium hirtum	rose clover	
Vulpia myros	rat's tail	Cal-IPC moderate
Vulpia bromoides	six weeks fescue	

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APPENDIX C

ALL *MONARDELLA VIMINEA* FOUND IN ALL WMEA SITES

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Appendix C. All *Monardella vimi*nea Found in All VMEA Sites

Canyon	Site	Treatment	AMEC	Blue Tag	Blue Tag	Blue Tag	Photo	MSR'd	Live/Dead/New/ Seedling/Missing	Notes
West Sycamore (E fork)	1	Control A	2	1189				x	L	in channel
	1	Control A	3	1190				x	L	
	1	Control A	4	1192				x	L	
	1	Control A	5	1205	1194			x	L	
	1	Control A	6	1193	1202	1203		x	L	channel edge; washed over
	1	Control A	7	1195				x	L	
	1	Control A	8	1176				x	L	
	1	Control A	9	1197				x	L	
	1	Control A	10	1198				x	L	
	1	Control A	11	1200				x	L	
	1	Control A	14	1206				x	L	
	1	Control A	15	1207				x	L	
West Sycamore (E fork)	1	Control B	1	1038				x	L	
	1	Control B	2	1039				x	L	
	1	Control B	3	1051	1041			x	L	diffuse clump
	1	Control B	4	1040				x	L	
	1	Control B	5	1044				x	L	
	1	Control B	6	1042				x	L	
	1	Control B	7	1052				x	L	
	1	Control B	8	1053				x	L	
	1	Control B	9	1053				x	L	
	1	Control B	10	no tag				x	L	
	1	Control B	11	1058				x	L	in channel
	1	Control B	12	1055				x	L	large clump
West Sycamore (E fork)	1	Weed	2	1134	1137			x	L	huge clump
	1	Weed	5	1138	1137			x	L	huge clump; into channel
	1	Weed	6	no tag				x	L	
	1	Weed	7	1140				x	L	
	1	Weed	8	1139				x	L	
	1	Weed	9	1141				x	L	
	1	Weed	10	1142				x	L	cobbled
	1	Weed	11	1147				x	L	
	1	Weed	12	no tag				x	L	
	1	Weed	13	1148				x	L	
	1	Weed	14	no tag				x	L	under EriFas
	1	Weed	18	1146				x	L	cobbled
	1	Weed	22	1161				x	L	
	1	Weed	27	1152				x	L	
West Sycamore (E fork)	1	Weed/Thatch	1	1077				x	L	
	1	Weed/Thatch	2	1079				x	L	washed over
	1	Weed/Thatch	3	1084			x	x	L	
	1	Weed/Thatch	4	1097			x	x	L	cobbled; clump
	1	Weed/Thatch	5	not recorded			x	x	L	

Canyon	Site	Treatment	AMEC	Blue Tag	Blue Tag	Blue Tag	Photo	MSR'd	Live/Dead/New/ Seedling/Missing	Notes
	1	Weed/Thatch	6	1099			x	x	L	cobbled
	1	Weed/Thatch	7	1100			x	x	L	cobbled
	1	Weed/Thatch	9	1104			x	x	L	
	1	Weed/Thatch	10	1087				x	L	
	1	Weed/Thatch	12	1086			x	x	L	
	1	Weed/Thatch	13	1089				x	L	in channel; washed over
	1	Weed/Thatch	14	1090				x	L	in channel; washed over
	1	Weed/Thatch	22	1107	1106			x	L	cobbled
	1	Weed/Thatch	36	1123			x	x	L	cobbled; falling into channel
West Sycamore (W fork)	2	Control	1	no tag				x	L	grown together with 2: clump
	2	Control	2	1327				x	L	
	2	Control	3	1328				x	L	
	2	Control	4	no tag				x	L	
	2	Control	5	no tag				x	L	
	2	Control	6	1329				x	L	
	2	Control	7	1332				x	L	
	2	Control	8	1331				x	L	
	2	Control	9	1333				x	L	
	2	Control	10	1334				x	L	
	2	Control	11	1335				x	L	cobbled
West Sycamore (W fork)	2	Weed	1	1315				x	L	in channel; washed over
	2	Weed	2	no tag				x	L	cobbled under *Eriodictyon*
	2	Weed	3	1316	1317	1318 1319		x	L	
	2	Weed	4	1320				x	L	cobbled
	2	Weed	5	no tag				x	L	
	2	Weed	6	1322				x	L	
	2	Weed	7	1321				x	L	
	2	Weed	8	1325				x	L	cobbled
	2	Weed	9	1324				x	L	channel edge; falling in
	2	Weed	10	gone					M	gone in 2011
	2	Weed	11	1320				x	L	cobbled
	2	Weed	12	no tag				x	L	in ToxDiv
	2	Weed	13	no tag				x	L	in ToxDiv
West Sycamore (W fork)	2	Weed/Thatch	1	gone					M	
	2	Weed/Thatch	2	1290				x	L	
	2	Weed/Thatch	3	1298				x	L	clump
	2	Weed/Thatch	11	1301				x	L	cobbled
	2	Weed/Thatch	12	1302				x	L	channel edge; eroded, falling in
	2	Weed/Thatch	13	1305				x	L	
	2	Weed/Thatch	14	1304				x	L	
	2	Weed/Thatch	15	1303				x	L	
	2	Weed/Thatch	16	1306				x	L	cobbled
	2	Weed/Thatch	18	1309	1311			x	L	clump
	2	Weed/Thatch	19	1308				x	L	
	2	Weed/Thatch	21	1312				x	L	cobbled; channel edge; washed over

Canyon	Site	Treatment	AMEC	Blue Tag	Blue Tag	Blue Tag	Photo	MSR'd	Live/Dead/New/ Seedling/Missing	Notes
	2	Weed/Thatch	22	1313				x	L	
Spring West	3	Control	1	1406			x	x	L	
	3	Control	2	1407			x	x	L	
	3	Control	3	1408			x	x	L	
Spring West	3	Weed	1	1397				x	L	cobbled; channel edge; falling in
	3	Weed	2	1398	1399		x	x	L	cobbled; channel edge; falling in
	3	Weed	3	1400	1401			x	L	
	3	Weed	4	1403			x	x	L	channel edge; falling in
	3	Weed	5	1404			x	x	L	in channel; washed over
	3	Weed	6	1402				x	L	cobbled
Spring West	3	Weed/Thatch	1	1388				x	L	
	3	Weed/Thatch	2	1389			x	x	L	
	3	Weed/Thatch	3	1390			x	x	L	channel edge; washed over
	3	Weed/Thatch	4	1391				x	L	channel edge; washed over
	3	Weed/Thatch	5	1392				x	L	channel edge; washed over
	3	Weed/Thatch	6	gone					M	gone from inside channel
	3	Weed/Thatch	7	1393				x	L	channel edge; washed over
	3	Weed/Thatch	8	1394				x	L	
	3	Weed/Thatch	9	1396				x	L	
San Clemente	4	Control	1	465				x	L	
	4	Control	2	466	467			x	L	
	4	Control	3	521				x	L	
	4	Control	4	468				x	L	
	4	Control	5	469	470			x	L	clump
	4	Control	6	471				x	L	
	4	Control	7	472				x	L	shown as clump
	4	Control	8	473				x	L	
	4	Control	9	474	475	476		x	L	
	4	Control	10	478	479	480		x	L	
	4	Control	11	498	518	520		x	L	huge clump
	4	Control	12	516				x	L	
San Clemente	4	W/T	1	456				x	M	plant gone in 2011
	4	W/T	2	455				x	L	
	4	W/T	3	454				x	L	
	4	W/T	4	454				x	L	
	4	W/T	5	451				x	L	channel edge; falling in
	4	W/T	6	452				x	L	
	4	W/T	7	458				x	L	
	4	W/T	8	459	461			x	L	near channel; washed over
	4	W/T	9	462				x	L	
	4	W/T	10	460	463			x	L	washed over
	4	W/T	12	457				x	L	
Spring East	5	Control	1	1476				x	L	
	5	Control	3	1478	1479			x	L	clump
	5	Control	4	1480	1481	1482		x	L	large diffuse clump

Canyon	Site	Treatment	AMEC	Blue Tag	Blue Tag	Blue Tag	Photo	MSR'd	Live/Dead/New/ Seedling/Missing	Notes
	5	Control	5	no tag				x	L	
	5	Control	6	no tag				x	L	
	5	Control	7	no tag			x	x	L	clump
	5	Control	8	no tag				x	L	
	5	Control	9	1486				x	L	
	5	Control	10	1490			x	x	L	washed over, falling in channel
	5	Control	11	1491				x	L	washed over; flotsam
	5	Control	12	1492			x	x	L	undercut by channel
	5	Control	14	no tag				x	L	
	5	Control	17	448				x	L	
	5	Control	18	446				x	L	
	5	Control	new 1	1487	1488	1489	x	x	L	new to 2010; not in database; undercut by channel
Spring East	5	Weed	2	440				x	L	
	5	Weed	3	437	439	441		x	L	
	5	Weed	4	438			x	x	L	
	5	Weed	5	436			x	x	L	channel edge; washed over
	5	Weed	6	434	435			x	L	
	5	Weed	7	433			x	x	L	
	5	Weed	8	430				x	L	clump
	5	Weed	9	427				x	L	cobbled
	5	Weed	10	428				x	L	cobbled
	5	Weed	11	1495				x	L	channel edge; eroding
	5	Weed	12	426	427			x	L	
	5	Weed	13	425				x	L	cobbled
	5	Weed	14	424				x	L	cobbled
Spring East	5	Weed/Thatch	1	417				x	L	
	5	Weed/Thatch	2	416				x	L	
	5	Weed/Thatch	3	415				x	L	
	5	Weed/Thatch	4	414				x	L	
	5	Weed/Thatch	5	413				x	L	channel edge; eroded
	5	Weed/Thatch	7	412				x	L	in channel on shrub island
	5	Weed/Thatch	8	1496				x	L	
	5	Weed/Thatch	11,12	no tag				x	L	
	5	Weed/Thatch	14	401	403			x	L	cobbled
	5	Weed/Thatch	16	396				x	L	
	5	Weed/Thatch	17	397	399			x	L	
	5	Weed/Thatch	19,20	391	402		x	x	L	
	5	Weed/Thatch	23	393				x	L	cobbled
	5	Weed/Thatch	25	389				x	L	cobbled
Plants with no dimension data										
	1	Control A	12	no tag					L	under BacSar
	1	Control A	13	1205					L	
	1	Control A	16	no tag					L	

Canyon	Site	Treatment	AMEC	Blue Tag	Blue Tag	Blue Tag	Photo	MSR'd	Live/Dead/New/ Seedling/Missing	Notes
	1	Control A	17	no tag					L	
	1	Control A	18	no tag					L	
	1	Control A	19	1282					L	
	1	Control A	20	1283					L	
	1	Control A	21	1283					L	
	1	Control A	22	1208					L	
	1	Control A	23	1211	1212				L	
	1	Control A	24	1213					L	
	1	Control A	25	1214					L	
	1	Control A	26	1215					L	
	1	Control A	27	1216					L	
	1	Control A	28	1217					L	
	1	Control A	29	1218					L	
	1	Control A	30	1219					L	
	1	Control A	31	1220					L	
	1	Control A	32	1221					L	
	1	Control A	33	1223					L	
	1	Control A	34	1225					L	
	1	Control A	35	1226					L	
	1	Control A	36	1227					L	
	1	Control A	37	1228					L	
	1	Control A	no tag	1222					N	new in stream
	1	Control B	13	1056					L	
	1	Control B	14	1047					L	
	1	Control B	15	1050					L	
	1	Control B	16	1046					L	
	1	Control B	17	1057					L	
	1	Control B	18	1057					L	
	1	Control B	19	1060					L	
	1	Control B	20	1062					L	
	1	Control B	21	1063					L	
	1	Control B	22	1064					L	
	1	Control B	23	1065					L	
	1	Control B	24	1061					L	
	1	Control B	25	1066					L	
	1	Control B	26	1091					L	
	1	Control B	27	1092					L	
	1	Control B	28	1093					L	
	1	Control B	29	1094					L	
	1	Control B	30	no tag					L	
	1	Control B	31	no tag					L	
	1	Control B	32	no tag					L	
	1	Control B	33	1095					L	
	1	Control B	34	1096					L	
	1	Control B	35	no tag					L	

Canyon	Site	Treatment	AMEC	Blue Tag	Blue Tag	Blue Tag	Photo	MSR'd	Live/Dead/New/ Seedling/Missing	Notes
	1	Control B	36	1067					L	
	1	Control B	37	1168					L	
	1	Control B	38	1069					L	
	1	Control B	39	1070					L	
	1	Control B	40	1072					L	
	1	Control B	41	1083					L	
	1	Control B	42	1082					L	
	1	Control B	43	1081					L	
	1	Control B	44	1080					L	
	1	Control B	45	1078					L	
	1	Control B	46	1075					L	
	1	Control B	47	1073					L	
	1	Control B	48	1072					L	
	1	Control B	49	1074					L	
	1	Control B	50	1073					L	
	1	Control B	51	1167					L	
	1	Control B	52	1071					L	
	1	Control B	53	1075	1075				L	
	1	Control B	54	1170					L	
	1	Weed	1	1132					L	
	1	Weed	3	1136					L	
	1	Weed	4	no tag					L	under RhaCal
	1	Weed	15	1150					L	
	1	Weed	16	1149	1150	1151			L	
	1	Weed	17	gone					M	
	1	Weed	19	1145					L	
	1	Weed	20						L	
	1	Weed	21	1144					L	
	1	Weed	13	1148					L	
	1	Weed	24	1159					L	
	1	Weed	25	1163					L	
	1	Weed	26	1157					L	
	1	Weed	28	1154					L	
	1	Weed	new	1177					N	in stream
	1	Weed	29	1162					L	
	1	Weed	30	1164					L	
	1	Weed	31	1165					L	
	1	Weed	32	1166					L	
	1	Weed	33	gone					M	
	1	Weed	34	1173					L	
	1	Weed	35	no tag					L	under BacSar
	1	Weed	36	1174	1175	1176			L	
	1	Weed	37	1179					L	
	1	Weed	38	1180					L	

Canyon	Site	Treatment	AMEC	Blue Tag	Blue Tag	Blue Tag	Photo	MSR'd	Live/Dead/New/ Seedling/Missing	Notes
	1	Weed	39	1184					L	
	1	Weed	40	1183					L	
	1	Weed	41	1185	1181	1182			L	
	1	Weed	42	1186					L	
	1	Weed	43	1187					L	
	1	Weed/Thatch	43	1133					L	
	1	Weed/Thatch	42	1125					L	
	1	Weed/Thatch	41	1126					L	
	1	Weed/Thatch	38	1128	1129				L	
	1	Weed/Thatch	34	1122					L	
	1	Weed/Thatch	41	1131					L	
	1	Weed/Thatch	32	1117					L	
	1	Weed/Thatch	30	1120					L	
	1	Weed/Thatch	29	1119					L	
	1	Weed/Thatch	23	1108					L	
	1	Weed/Thatch	not known	1135					L	15?
	1	Weed/Thatch	not known	1124					L	16?
	1	Weed/Thatch	not known	1127					L	17?
	1	Weed/Thatch	not known	1130					L	18?
	1	Weed/Thatch	not known	1118					L	19?
	1	Weed/Thatch	not known	1111					L	20?
	1	Weed/Thatch	not known	1112					L	21?
	1	Weed/Thatch	not known	1113					L	24?
	1	Weed/Thatch	not known	1114	1115	1116			L	25?
	1	Weed/Thatch	not known	1110					L	26?
	1	Weed/Thatch	not known	1109					L	27?
	1	Weed/Thatch	not known	1105					L	28?
	1	Weed/Thatch	not known	1098					L	31?
	1	Weed/Thatch	not known	1102					L	33?
	1	Weed/Thatch	not known	1103					L	35?
	1	Weed/Thatch	not known	1121					L	37?
	2	Weed	no tag	1223					N	
	2	Weed/Thatch	13	1314					L	
	2	Weed/Thatch	17	no tag					L	
	2	Weed/Thatch	20	no tag					L	
	2	Weed/Thatch	4	gone					M	
	2	Weed/Thatch	5	1300					L	
	2	Weed/Thatch	6	gone					M	
	2	Weed/Thatch	7	gone					M	
	2	Weed/Thatch	8	gone					M	
	2	Weed/Thatch	9	gone					M	
	2	Weed/Thatch	10	gone					M	
	2	Weed/Thatch	2010 new 2	1297					L	
	3	Weed	seedling	no tag			x		S	
	3	Weed/Thatch	new	1395			x		N	new in channel

Canyon	Site	Treatment	AMEC	Blue Tag	Blue Tag	Blue Tag	Photo	MSR'd	Live/Dead/New/ Seedling/Missing	Notes
	3	Weed/Thatch	seedling	no tag					S	
	4	W/T	11	gone					M	
	4	W/T	new	no tag					S	6" seedling
	4	Control	13	515					L	
	4	Control	14	497					L	
	4	Control	15	499					L	
	4	Control	16	502	514				L	
	4	Control	17	481					L	
	4	Control	18	517					L	
	4	Control	19	482	483				L	
	4	Control	20	484					L	
	4	Control	21	485					L	
	4	Control	22	501					L	
	4	Control	23	513					L	
	4	Control	24	502					L	
	4	Control	25	506					L	
	4	Control	26	486					L	
	4	Control	27	505					L	
	4	Control	28	no tag					L	
	4	Control	29	504	503				L	
	4	Control	30	507					L	
	4	Control	31	508					L	
	4	Control	32	510					L	
	4	Control	33	509					L	
	4	Control	34						L	Under Large EriFas
	4	Control	35	511					L	
	4	Control	36	523					L	
	4	Control	37	487					L	
	4	Control	38	488					L	
	2	Weed	no tag	no tag					N	mature plant capture in flotsom of tree
	4	Control	40	512	498	490			L	
	4	Control	41	494	495	493			L	Blue tags extend upstream
	5	Weed/Thatch	6	411					L	
	5	Weed/Thatch	not known	409	410				L	
	5	Weed/Thatch	9	408			x		L	
	5	Weed/Thatch	10	406					L	
	5	Weed/Thatch	13	404					L	
	5	Weed/Thatch	15	398	395				L	
	5	Weed/Thatch	18	392					L	
	5	Weed/Thatch	21	390					L	
	5	Weed/Thatch	24	387					L	
	5	Weed/Thatch	28	394					L	
	5	Weed/Thatch	22	400	388				L	
	5	Weed/Thatch	27	384					L	

Canyon	Site	Treatment	AMEC	Blue Tag	Blue Tag	Blue Tag	Photo	MSR'd	Live/Dead/New/ Seedling/Missing	Notes
	5	Weed/Thatch	26	385					L	
	5	Control	2	1477					L	
	5	Control	13	449	450				L	
	5	Control	15	1493					L	
	5	Control	19	445					L	
	5	Control	20	444					L	
	5	Control	16	447					L	
	5	Control	21	443					L	
	5	Weed	1	442					L	
	5	Weed	15	423	421				L	
	5	Weed	16	420					L	
	5	Weed	17	419					L	
	5	Weed	no tag	no tag					N	large plant in LotSco and EriFas
	5	Weed	seedling	no tag					S	near plant 16,17
	2	Weed/Thatch	seedling	no tag			x		S	
	2	Weed/Thatch	seedling	no tag			x		S	
	1	Weed	seedling	no tag			x		S	new seedling in stream
	1	Control B	seedling	no tag			x		S	
	1	Control A	seedling	no tag					S	in stream
	1	Control A	seedling	no tag					S	in stream
	1	Control A	seedling	no tag					S	in stream
	1	Control A	seedling	no tag					S	in stream
	1	Control A	seedling	no tag					S	in stream
	1	Control A	seedling	no tag					S	in stream
	1	Control A	seedling	no tag					S	in stream
	1	Control A	seedling	no tag					S	in stream
	1	Control A	seedling	no tag					S	in stream
	1	Control A	seedling	no tag					S	in stream
	1	Control A	seedling	no tag					S	in stream
	1	Control A	seedling	no tag					S	somewhat larger 6 inch plant
	1	Control A	seedling	no tag					S	somewhat larger 6 inch plant