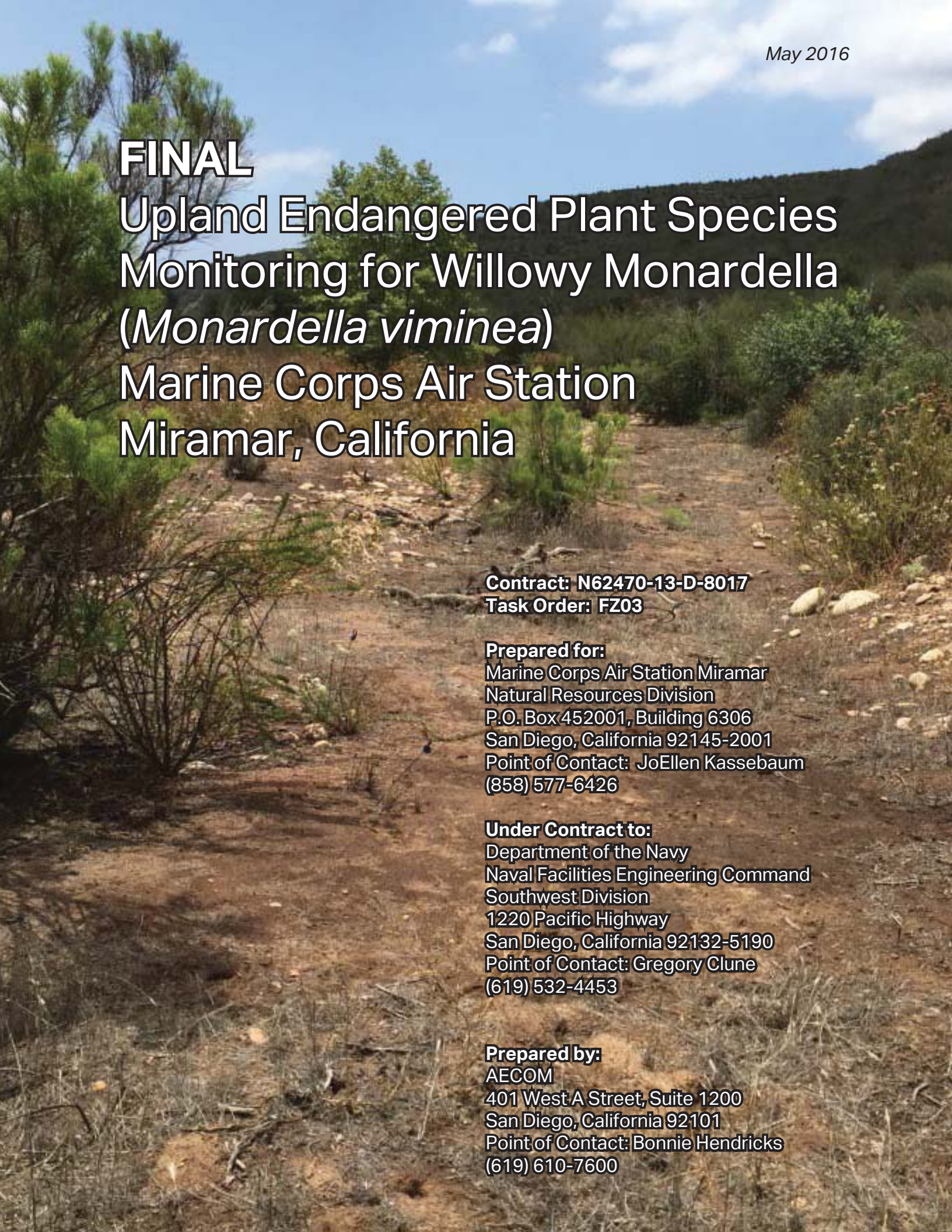


May 2016

FINAL
Upland Endangered Plant Species Monitoring for Willowy Monardella (*Monardella viminea*) Marine Corps Air Station Miramar, California

Contract: N62470-13-D-8017
Task Order: FZ03

Prepared for:
Marine Corps Air Station Miramar
Natural Resources Division
P.O. Box 452001, Building 6306
San Diego, California 92145-2001
Point of Contact: JoEllen Kassebaum
(858) 577-6426

Under Contract to:
Department of the Navy
Naval Facilities Engineering Command
Southwest Division
1220 Pacific Highway
San Diego, California 92132-5190
Point of Contact: Gregory Clune
(619) 532-4453

Prepared by:
AECOM
401 West A Street, Suite 1200
San Diego, California 92101
Point of Contact: Bonnie Hendricks
(619) 610-7600

FINAL REPORT
UPLAND ENDANGERED PLANT SPECIES MONITORING FOR WILLOWY MONARDELLA (*Monardella viminea)*
MARINE CORPS AIR STATION MIRAMAR, CALIFORNIA

Contract: N62470-13-D-8017
Task Order: FZ03

Prepared for:

Marine Corps Air Station Miramar
Natural Resources Division
P.O. Box 452001, Building 6306
San Diego, California 92145-2001
Point of Contact: JoEllen Kassebaum
(858) 577-6426

Under Contract to:

Department of the Navy
Naval Facilities Engineering Command Southwest Division
1220 Pacific Highway
San Diego, California 92132-5190
Point of Contact: Gregory Clune
(619) 532-4453

Prepared by:

AECOM
401 West A Street, Suite 1200
San Diego, California 92101
Point of Contact: Bonnie Hendricks
(619) 610-7600

May 2016

TABLE OF CONTENTS

Section **Page**

LIST OF ACRONYMS AND ABBREVIATIONS iv

EXECUTIVE SUMMARY 1

CHAPTER 1 – INTRODUCTION 1
- 1.1 Purpose 1
- 1.2 Project Location 1
- 1.3 Site Description 2

CHAPTER 2 – METHODS 7
- 2.1 Project Implementation 7
  - 2.1.1 Surveys 7
  - 2.1.2 Plot Maintenance and Establishment 8
  - 2.1.3 Data Collection 8
  - 2.1.4 Project Team and Surveyor Qualifications 10
- 2.2 Analysis 11
  - 2.2.1 Clump Growth Rate 11
  - 2.2.2 Multiple Regression Calculations and Analysis 12
  - 2.2.3 Photographic Comparison 13
  - 2.2.4 Rainfall Data 13

CHAPTER 3 – RESULTS 15
- 3.1 Clump Losses and Gains 15
- 3.2 Clump Growth Rate 16
- 3.3 Multiple Regression Calculations and Analysis 18
- 3.4 Monitoring Data Results 18
- 3.5 Photographic Comparison 21
- 3.6 Rainfall Data 22

CHAPTER 4 – DISCUSSION 25
- 4.1 Observed Trends 25
  - 4.1.1 Clump Growth, Mortality, and Recruitment 25
  - 4.1.2 Regression Analysis 25
  - 4.1.3 Herbivory 26

4.1.4 Pollinators 26
4.1.5 Disturbance 27
4.2 Conclusion 27

CHAPTER 5 – REFERENCES 29

APPENDICES
A Field Data Sheets for Monitoring Plots
B Field Data Sheets for Monitoring Clumps
C Monitoring Plot Maps (Figures 3-1 to 3-16)
D Project Photographs
E Monitoring Plot Photographs

LIST OF FIGURES

Figure **Page**

1 Project Location Map 3
2 Willowy Monardella Monitoring Plot Locations 5
3-1 Willowy Monardella Monitoring Plot A ..... Appendix C
3-2 Willowy Monardella Monitoring Plot C ..... Appendix C
3-3 Willowy Monardella Monitoring Plot G ..... Appendix C
3-4 Willowy Monardella Monitoring Plot H ..... Appendix C
3-5 Willowy Monardella Monitoring Plot I ..... Appendix C
3-6 Willowy Monardella Monitoring Plot J ..... Appendix C
3-7 Willowy Monardella Monitoring Plot L ..... Appendix C
3-8 Willowy Monardella Monitoring Plot N & O ..... Appendix C
3-9 Willowy Monardella Monitoring Plot P ..... Appendix C
3-10 Willowy Monardella Monitoring Plot Q ..... Appendix C
3-11 Willowy Monardella Monitoring Plot R ..... Appendix C
3-12 Willowy Monardella Monitoring Plot S ..... Appendix C
3-13 Willowy Monardella Monitoring Plot T ..... Appendix C
3-14 Willowy Monardella Monitoring Plot U ..... Appendix C
3-15 Willowy Monardella Monitoring Plot V ..... Appendix C
3-16 Willowy Monardella Monitoring Plot W ..... Appendix C

LIST OF TABLES

Table		Page
1-1	Monitoring Plots within Each Watershed	2
2-1	Field Staff and Schedule	7
2-2	Biologists and Botanical Survey Experience	10
2-3	Growth Rate Calculation Exclusions	12
3-1	Clump Losses and Gains	16
3-2	Plot Growth Rate	16
3-3	Life Stage Totals	19
3-4	Phenological Stage Totals	20
3-5	Residual Dry Matter (RDM) Results	20
3-6	Number of Clumps within each Drainage Position	21
3-7	Photographic Comparison	22

LIST OF ACRONYMS AND ABBREVIATIONS

GIS	geographic information system
GPS	global positioning system
I-15	Interstate 15
MCAS	Marine Corps Air Station
RDM	residual dry matter

EXECUTIVE SUMMARY

This report summarizes the results of the 2015 monitoring surveys for the federally endangered willowy monardella (*Monardella viminea*) conducted on Marine Corps Air Station Miramar by AECOM biologists in July 2015. Monitoring was completed at 11 monitoring plots previously established by the San Diego Natural History Museum. Additionally, six new monitoring plots were established by installing boundary stakes in the field and establishing photograph points. Each willowy monardella clump within the monitoring plots was mapped and measured.

Overall, the monitoring plots have seen a decrease in willowy monardella individuals. Thirty-eight individual willowy monardella clumps have died since the last monitoring event in 2012, while only 16 new individuals were observed. Within the 11 previously monitored plots, however, close to two-thirds (60%) of the willowy monardella clumps monitored in 2012 that survived to the 2015 monitoring period saw positive growth rates, while slightly more than one-third of clumps decreased in size during this period. When dead clumps and new clumps are included in the analysis, only one-third of the individual clumps saw positive growth or were new since the previous monitoring event, while the remaining clumps were smaller than in 2012 or dead.

Results also indicated a positive relationship between clump size and amount of surrounding shrub cover from other species, suggesting a possible beneficial influence of neighboring shrubs on willowy monardella growth. Alternatively, the physical conditions in these plots may be more favorable to growth for both willowy monardella and other shrub species.

While top-forage herbivory was only seen in one individual in 2015, several clumps throughout all 17 plots had seed heads that contained micro moth larvae (Microlepidoptera), which were feeding on seeds. Insect pollination was observed on several willowy monardella clumps.

A comparison of photographs taken at previously established photograph points was conducted. Where non-native grass cover was prominent in 2012, it was observed to have decreased by 2015. In general, all vegetation within the monitoring plots appeared drier. Shrub and tree cover within the plots saw little to no change since 2012.

This page intentionally left blank.

CHAPTER 1
INTRODUCTION

The willowy monardella (*Monardella viminea*) monitoring development was initiated by the San Diego Natural History Museum in 2006, and the protocol was revised in 2013 by Tetra Tech. This report summarizes the results of the long-term monitoring surveys conducted on Marine Corps Air Station Miramar (MCAS Miramar or Station) by AECOM biologists in July 2015. The census and monitoring protocol (Tetra Tech 2013a) was reviewed prior to conducting monitoring surveys. The willowy monardella monitoring surveys and data collection and analysis were conducted in accordance with the established protocol.

1.1 PURPOSE

Willowy monardella is a federally endangered plant species protected under the Endangered Species Act of 1973 (USFWS 1996). MCAS Miramar is committed to managing and protecting this endangered plant. These requirements are detailed in the Endangered Species Act of 1973 (19 United States Code 1531 et seq.); Department of Defense Instruction 4715.3 Environmental Conservation Program; Marine Corps Order P5090.2A Ch.3, paragraphs 11104.3a and 11202.1; and MCAS Miramar Commanding Officer's Environmental Policy Statement.

The objectives of long-term willowy monardella monitoring are to determine population expansion or contraction, measure growth rates of willowy monardella within established monitoring plots, determine clump health, and identify key environmental factors impacting growth of the species. A protocol to conduct monitoring and census surveys has been developed for willowy monardella, and was finalized in 2013. The protocol allows MCAS Miramar to consistently track the local abundance and distribution of this species, as well as the growth rate and health of the local populations and habitat quality. Tracking the status and trend of this species allows MCAS Miramar to make informed stewardship decisions and fulfill the requirements of the aforementioned directives.

1.2 PROJECT LOCATION

MCAS Miramar is located in northwestern San Diego County, 13 miles north of downtown San Diego and 4 miles east of the Pacific Ocean (Figure 1). The entire Station consists of 23,015 acres. East Miramar, where this project was conducted, covers approximately 17,000 acres east of Interstate 15 (I-15).

Designated areas of East Miramar are used for military training, and the remainder is undeveloped. The largely undeveloped status of East Miramar is required in order to ensure the safety and security of facilities (e.g., aircraft approach corridors, small arms ranges, Explosive Ordnance Disposal facilities), and to maintain accident potential zones for military aircraft (MCAS Miramar 2011).

1.3 SITE DESCRIPTION

The willowy monardella monitoring plots are located in East Miramar, which is defined as the area east of I-15, and north of Highway 52. The area is characterized by coastal foothills and canyons of moderate to steep slopes, and mesas dominated largely by chaparral and coastal scrub. The average elevation is approximately 415 feet (135 meters).

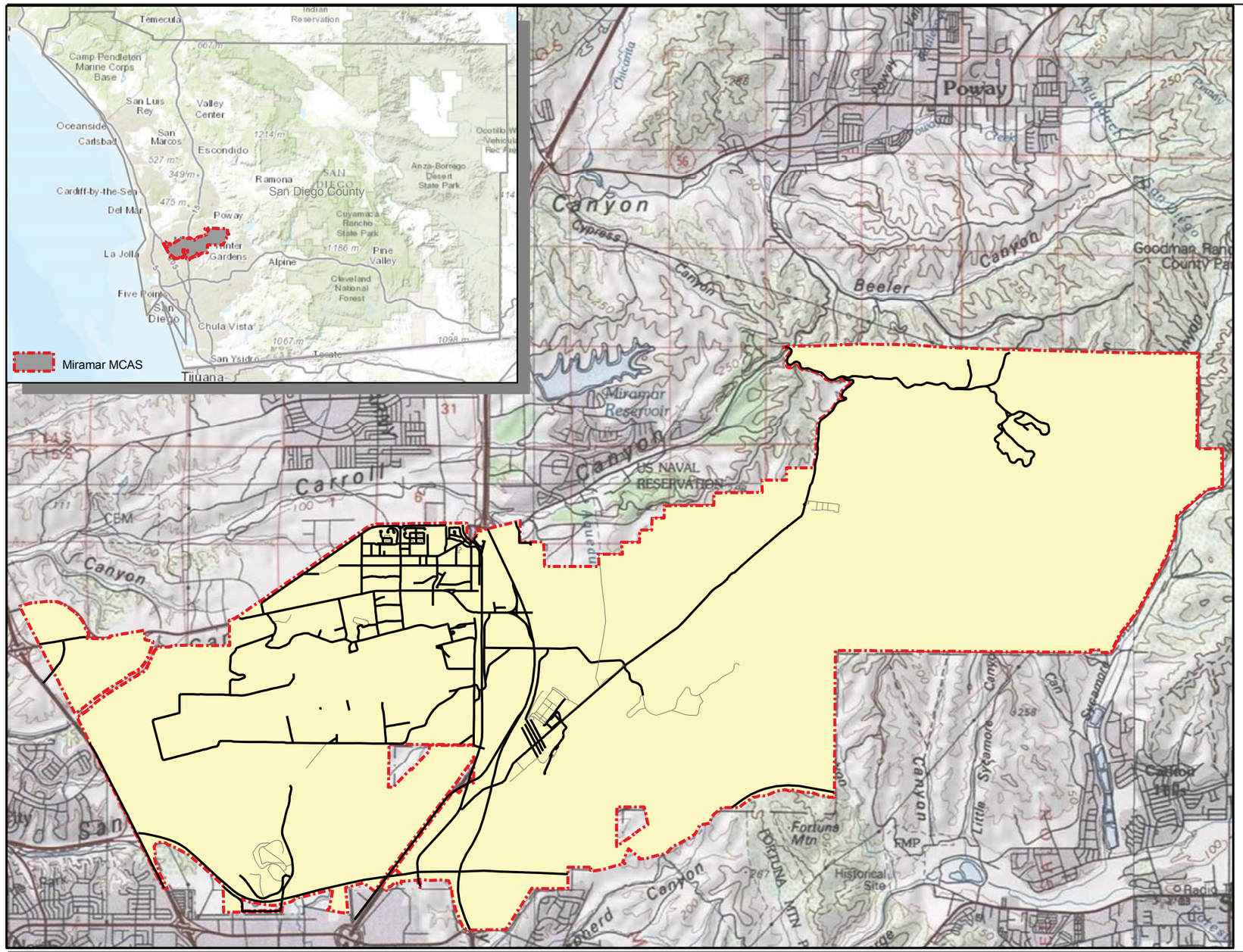
Occupied and potentially suitable habitat for willowy monardella is located throughout the eastern portion of MCAS Miramar within portions of the following watersheds: Rose Canyon, San Clemente Canyon, Elanus Canyon, Murphy Canyon, Oak Canyon, Spring Canyon, Quail Canyon, West Sycamore Canyon, and Sycamore Canyon.

Seventeen monitoring plots were surveyed by AECOM during July 2015. Table 1-1 summarizes the location of each monitoring plot surveyed in 2015. Figure 2 displays the location of each monitoring plot.

Table 1-1
Monitoring Plots within Each Watershed

Watershed	Drainage Type	Monitoring Plot
San Clemente Canyon	Primary	P, Q
Spring Canyon[1]	Secondary	R, S, T
West Sycamore Canyon	Primary	G, H,
	Secondary	A, C, I, J, L, N, O
Sycamore Canyon[1]	Primary	U, W
	Secondary	V

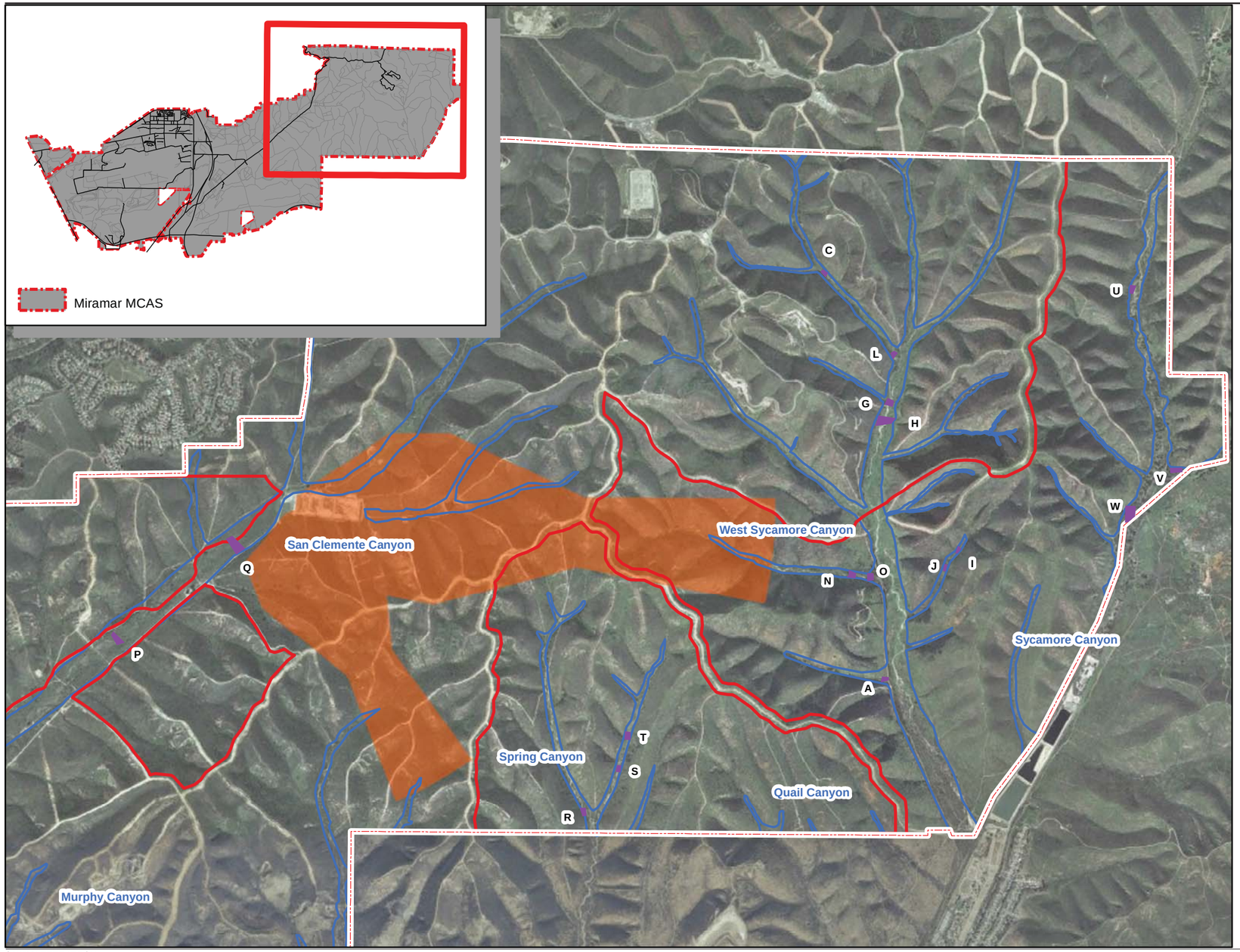
[1] Newly established monitoring plots



Source: TETRATECH

Figure 1
Project Location Map

This page intentionally left blank.



Legend

- MCAS Boundary
- Training Area
- Monitoring Plot Polygons
- Willowy Monardella Survey Area
- Surface Danger Zone
- A-W Monitoring Plot

Source: TETRATECH

0 0.25 0.5 1 Miles

Figure 2
Willowy Monardella Monitoring Plot Locations

This page intentionally left blank.

CHAPTER 2
METHODS

2.1 PROJECT IMPLEMENTATION

2.1.1 Surveys

Seventeen monitoring plots for willowy monardella (Figure 2) were evaluated according to the willowy monardella field protocol (San Diego Natural History Museum, 2006; Tetra Tech update, 2013a), which focuses on willowy monardella clump size, life stage, phenology, drainage characteristics, surrounding vegetative cover and residual dry matter, and natural history observations as summarized in Section 2.1.3 below.

Since the monitoring plots were established in 2006, a total of 17 monitoring plots have been included in the project. Due to six of the original plots containing few or no willowy monardella clumps (plots B, D, E, F, M, and K), six new monitoring plots (R, S, T, U, V, and W) were established in Spring Canyon and Sycamore Canyon per the protocol to replace the original set of six that had few to no clumps.

Monitoring surveys occurred during the weeks of July 13 and 20, 2015. Table 2-1 lists the biologists that completed fieldwork, and the corresponding dates.

Table 2-1
Field Staff and Schedule

Date of Field Work	Plots Surveyed	Field Biologists
July 14, 2015	P, Q	Jenna Hartsook Bonnie Hendricks John Messina
July 15, 2015	A, O, N, H	Jenna Hartsook John Messina
July 16, 2015	H, C, L, G	Jenna Hartsook Bonnie Hendricks
July 17, 2015	I, J, T, S	Jenna Hartsook Sundeep Amin
July 20, 2015	R, U, V, W	Jenna Hartsook Sundeep Amin
July 21, 2015	W	Jenna Hartsook

Monitoring data collection included locating previously mapped clumps, assessment of clumps of plants (determined through assessment of separation of clumps by more than 24 inches in accordance with the protocols), and mapping of clumps using subfoot accuracy global positioning system (GPS). Data were collected at each clump, and for each monitoring plot. A list of data collected can be found in Section 3.2. Field data sheets containing monitoring plot data and clump data can be found in Appendix A and Appendix B, respectively.

Live, previously tagged clumps; dead clumps, which had tags at the time of the survey; and new clumps were mapped. A few live previously tagged clumps were found that had not been previously mapped but were mapped during this monitoring event. Where clumps were previously mapped and still alive, but had apparently lost their tags, a new tag was installed. Missing clumps that were previously mapped and tagged were presumed dead, whether or not the tag was located. Previously mapped clumps that were declared dead and had no tag during the time of the survey were not mapped with GPS.

2.1.2 Plot Maintenance and Establishment

Plot boundary stakes were inspected and mapped at each plot. The southwest corner stake of Plot A was not found; therefore, it was replaced. The northwest corner stake of Plot N was also missing and was replaced. All other preexisting delineating stakes were still in place; however, some were hard to find because they were located within vegetation.

Six of the 17 plots had not been previously monitored. Three of these plots are located in Spring Canyon, and three are located in Sycamore Canyon. The plots had not been delineated in the field with boundary stakes. However, the plot boundaries had been established in a geographic information system (GIS); therefore, AECOM biologists used subfoot accuracy GPS to find plot corners, and installed stakes at each plot corner. A few of the stakes were installed closely adjacent to plot corners due to the boundary in GIS being located on a steep slope in the field, or due to the plot boundary being located within dense vegetation. This was done for the safety of field personnel and to provide increased visibility for future surveyors. Photograph points for these plots were also established and staked in the field. All installed stakes were mapped using subfoot accuracy GPS.

2.1.3 Data Collection

A Trimble GPS Pathfinder ProXRT Receiver and a Trimble Yuma 2 Rugged Tablet Computer with ArcPad software were used for the willowy monardella monitoring. The GPS unit was

programmed with a data dictionary designed to record the following monitoring information for each individual willowy monardella clump:

- Center point of each clump recorded with a subfoot accuracy GPS unit.
- Each individual willowy monardella clump was recorded in state plane coordinates, Zone 6, NAD 83, units feet.
- Clump tag number.
- Clump activity (historically active [dead], or currently active)

Attribute data for each clump were collected with a Microsoft Surface Pro tablet, using a Microsoft Access Database, which was designed to collect the data outlined in the protocol as follows:

- Phenology (vegetative, budding, flowering, seedling, and (dormant/dead states).
- Life stage (seedling, juvenile, mature, adult).
- Location of each individual clump within the drainage (drainage channel bottom, meandering drainage bank, or alluvial benches/flats).
- Drainage type (primary, secondary, tertiary).
- Residual dry matter (RDM) (no RDM, minimal RDM, dense thatch).
- Special observations (disturbance or natural history observations, including pollinators or herbivory associated with the clump).
- Changes associated with clump number tags (missing tag, clump no longer exists, etc.).

For each monitoring plot, the required data were recorded using a Microsoft Surface Pro tablet. A Microsoft Access Database was created to allow the collection of data outlined in the protocol. Plot data collection included:

- Name(s) of surveyor(s)
- Date
- Monitoring plot I.D.
- Photograph number and aspect
- Depth of the drainage
- Whether the drainage was mapped
- Number of individuals within each life stage category

- Number of individuals within each phenology category
- Dominant plant species within the plot, and their relative percent cover

The census and monitoring data were collected using GPS data dictionaries and electronic databases. Horizontal accuracies were subfoot. Elevation data were not required and therefore were not recorded. Post-processing, including differential correction, was performed after completion of fieldwork. The UNAVCO, San Diego, CA (p475) base station was used for differential correction. This base station meets the following criteria: (1) it is less than 25 kilometers from MCAS Miramar, (2) it has an integrity index of 80 or higher, and (3) it provides 95 percent or higher subfoot differential correction accuracy.

Post-processed field GPS data were converted to ESRI GIS data. GIS data will be provided in file geodatabase format. Feature datasets and feature classes follow the GIS data dictionary obtained prior to fieldwork.

2.1.4 Project Team and Surveyor Qualifications

The AECOM project team includes several botanists and GIS specialist Nick Janssen. Bonnie Hendricks, project manager, coordinated the field schedule, participated in field surveys, data analysis, and writing, and provided technical oversight for all aspects of the project. Bonnie Hendricks, John Messina, and Sundeep Amin served as field task managers. AECOM biologist Jenna Hartsook was a key team member, who participated throughout the entirety of the field surveys and was a primary author of the monitoring report. The field team conducted plant surveys, established survey plots, conducted GPS mapping, and performed data quality assurance/quality control and data analysis.

Table 2-2 lists the AECOM staff who participated in this project, their role in the project, and their number of years of experience conducting similar surveys.

Table 2-2
Biologists and Botanical Survey Experience

Name	Project Role	Vegetation Mapping and Rare Plant Surveys (years of experience)	Willowy Monardella Surveys (years of experience)
Bonnie Hendricks	Project Manager, Field Task Manager	25	15
John Messina	Field Task Manager	25	5
Sundeep Amin	Field Task Manager	11	1
Jenna Hartsook	Field Team Member	3	1

2.2 ANALYSIS

The electronic data were uploaded to the computer and combined with GPS data into an Excel spreadsheet for data analysis. Systat software was also used for data analysis.

2.2.1 Clump Growth Rate

Clump growth rate was calculated to determine how the clumps have changed over time. Growth rate was analyzed for the previously monitored plots only, because clump height, diameter, and width data were not available to be compared for the six new plots. To calculate the rate of growth, elliptical area and volume were calculated for each individual willowy monardella clump within each plot using the clump diameter, width, and height data, and the formulas below:

Elliptical Area = π * (1/2 of the Clump Diameter) * (1/2 of the Clump Width)

Elliptical Volume = Elliptical Area * Clump Height

Growth rate was calculated using the formula below:

$$\text{Clump Growth Rate} = \left[\frac{\text{Elliptical Area or Volume at Time 2}}{\text{Elliptical Area or Volume at Time 1}}\right] - 1$$

The growth rate was calculated for each clump using both elliptical area and volume. The data were analyzed in two ways:

1. Calculating the ratio of clumps with positive growth rates to the total number of clumps within each plot[1]:

   Ratio of clumps with positive growth rate = Number of clumps within plot with positive growth rate : Total number of clumps within plot

   [1]Ratio of clumps with positive growth rate was calculated using data for existing (negative/ positive growth rate), dead (negative growth rate), and new clumps (positive growth rate) in the calculation.

2. Calculating the average growth rate of each monitoring plot[2]:

   Average growth rate = Sum of growth rates for clumps within plot/Total number of existing clumps within plot

   [2]Average growth rate of clumps was calculated using only previously mapped, existing clumps.

Some clumps had to be excluded from the analysis of the growth rate calculations. Table 2-3 summarizes how different clump circumstances affected the analysis of the growth rate calculation(s).

Table 2-3
Growth Rate Calculation Exclusions

Clump Status	Effect on Growth Rate Analysis	Justification
Dead Clumps	Included in Positive Growth Rate Ratio calculation, but not Average Growth Rate calculation	No quantifiable growth rate could be calculated for dead clumps
New Clumps	Included in Positive Growth Rate Ratio calculation, but not Average Growth Rate calculation	Elliptical area/volume at time 1 would be 0 (can't divide by 0); No quantifiable growth rate could be calculated for new clumps
Split Clumps	Not included in either growth rate calculation	Not directly comparable to previous monitoring event's data.
Combined Clumps	Not included in either growth rate calculation	Not directly comparable to previous monitoring event's data.
Existing Tagged Clumps (Previously Mapped)	Included in both growth rate calculations	not applicable
Previously Tagged Clumps Not Previously Mapped	Not included in either growth rate calculation	Not directly comparable to previous monitoring event's data; if included as "new" clumps, positive growth would be falsely favored.

2.2.2 Multiple Regression Calculations and Analysis

A regression analysis was used to determine how the amount of bare ground, native herb cover, non-native herb cover, shrub cover, tree cover, residual dry matter, herbivory, and drainage type correlated to the size of the individual willowy monardella clumps in 2015. Prior to running the regression analysis, vegetation coverage estimates were rounded to the nearest 5 percent, as stated in the protocol. Coverage of non-native grasses and native grasses were all less than 2 percent, and therefore were rounded down to zero. These two variables were excluded from the analysis due to the percent cover being zero for all clumps. Noncontinuous variables, including

herbivory, drainage type, and residual dry matter, were assigned a numerical value prior to the analysis.

The regression analysis was completed using both Excel and Systat software. Outliers were determined by looking at a three-dimensional model using Systat software.

The regression was run in multiple ways to determine the best way to present the data. Elliptical area and volume were used separately as dependent variables. Regression analyses were run using nontransformed data, as well as log transformed data. Ultimately, it was determined that using elliptical area rather than volume would be the preferred dependent variable over elliptical volume due to some of the clump heights being very tall, causing more outliers when using elliptical volume.

2.2.3 Photographic Comparison

Photographs were taken at each of the 11 preestablished photograph points to be compared to photographs taken at the same location and aspect during the 2012 monitoring event. Photographs were also taken at photograph points established in the six new plots during the 2015 monitoring event; however, they will not be able to be compared until the next monitoring event. At least two photographs were taken at each photograph point.

2.2.4 Rainfall Data

Total rainfall (from July 1, 2014 through June 30, 2015) for the survey region was calculated and compared to average total rainfall in relation to population data collected during the monitoring surveys in order to determine the impact that rainfall might have had on willowy monardella growth rates.

This page intentionally left blank.

CHAPTER 3
RESULTS

Results are provided below for willowy mondardella monitoring plots within the four primary canyons and their tributaries, San Clemente Canyon, Spring Canyon, West Sycamore Canyon, and Sycamore Canyon. An overview of monitoring plot locations is shown in Figure 2 and more detailed maps of the monitoring plots are included in Appendix C in Figures 3-1 to 3-16. General photographs of willowy monardella including habitat, slope positions, herbivores, and pollinators are included in Appendix D.

3.1 CLUMP LOSSES AND GAINS

A total of 38 willowy monardella clumps have been lost, and are assumed to have died, since the previous survey. A total of 16 new clumps have been recorded since the previous survey. A total of 189 live clumps, including previously monitored and newly tagged clumps, were monitored in 2015 (Figures 3-1 to 3-16 in Appendix C). Table 3-1 summarizes the total number of dead and live clumps, including new clumps since the previous monitoring effort for each monitoring plot.

Two occurrences of clump combination were observed in Plots I (clumps 1240 and 1243) and S (clumps 251 and 252). One occurrence of clump splitting was observed in Plot C (clump 375 had split, so a new tag, 1621, was installed). Five clumps that were previously tagged, but not previously mapped were found in the following plots: Plots I (clump 1236), J (clump 1255), L (clump 1563), Q (clump 875), and V (clump 71).. These clumps were mapped during the 2015 monitoring event[1]; however, they were not included as new clumps because they were tagged during a previous census event.

Plot H, within West Sycamore Canyon and plot U, within Sycamore Canyon saw the highest mortality rates, containing approximately 40 percent of the observed dead clumps when combined. Plot S, within Spring Canyon, and plot W, within Sycamore Canyon, saw the greatest amount of new individuals; containing approximately 80 percent of newly recorded individuals when combined.

[1] Clump 1236 was tagged during the 2012 survey and detected in the 2015 survey, but was missed during the GPS mapping for both survey events. Attribute data for this clump was taken in 2015.

Table 3-1
Clump Losses and Gains

Monitoring Plot	Total Number of Live Clumps[1]	Number of Dead Clumps	Dead Clump Tag I.D.'s	Number of New Clumps	New Clump Tag I.D.'s
A	5	0	n/a	0	n/a
C	2	0	n/a	0	n/a
G	3	2	1771, 1762	0	n/a
H	9	7	1528, 1529, 1763, 1773, 1775, 1776, 1779	0	n/a
I	27	0	n/a	1	1505
J	12	0	n/a	0	n/a
L	4	0	n/a	0	n/a
N	5	5	1543, 1549, 1550, 1892, 1894	0	n/a
O	1	0	n/a	0	n/a
P	12	3	922, 923, 929	0	n/a
Q	15	2	75, 854	0	n/a
R	13	4	1523, 1560, 1572, 1573	0	n/a
S	20	1	1412	5	1501, 1834, 1836, 1840, 1984
T	10	1	201	1	188
U	11	9	310, 313, 314, 317, 334, 335, 340, 342, 345	0	n/a
V	21	1	123	1	1500
W	19	3	81, 104, 109	8	1506, 1520, 1752, 1858, 1902, 1905, 1906, 1910
Total	**189**	**38**	**n/a**	**16**	**n/a**

n/a = not applicable
[1] Includes new clumps, combined clumps, and split clumps

3.2 CLUMP GROWTH RATE

Growth rate was calculated for each individual willowy monardella clump and analyzed in two ways, as outlined in Section 2.2.1. The results and growth rate summaries for each plot are shown in Table 3-2.

Table 3-2
Plot Growth Rate

Monitoring Plot	Number of Existing Live Clumps Monitored in 2012 and 2015[1]	Number of Dead Clumps	Number of New Clumps	Ratio of Clumps with Positive Growth Rate Based on Area (Percent)[2]	Ratio of Clumps with Positive Growth Rate Based on Volume (Percent)[3]	Average Growth Rate Based on Area (sq. cm)[4]	Average Growth Rate Based on Volume (cu. cm)[5]
A	5	0	0	**1:5 (20.0)**	1:5 (20.0)	-0.25	-0.57
C	0	0	0	**n/a**	n/a	n/a	n/a
G	3	2	0	**2:5 (40.0)**	2:5 (40)	0.38	0.10
H	9	7	0	**2:16 (12.5)**	0:16 (0.0)	-0.35	-0.58
I[6]	21	0	1	**14:22 (63.6)**	10:22 (45.5)	43.01	123.42
J[6]	11	0	0	**6:11 (54.5)**	6:11(54.5)	19.00	47.18
L	3	0	0	**1:3 (33.3)**	1:3 (33.3)	-0.092	-0.36
N	5	5	0	**5:10 (50.0)**	5:10 (50.0)	82.73	206.72
O	1	0	0	**0:1 (0.0)**	0:1 (0.0)	-0.39	-0.32
P	12	3	0	**2:15 (13.3)**	1:15 (6.7)	-0.42	-0.58
Q	14	2	0	**2:16 (12.5)**	0:16 (0.0)	-0.43	-0.62
Total	**84**	**19**	**1**	**35:104 (33.7)**	**26:104 (25.0)**	**17.99**	**49.04**

[1] Column represents total number of live clumps monitored during 2012 and 2015. The number does not include dead or new clumps.

[2] Column represents the preferred indicator for growth; calculated as the number of live clumps with positive growth rate from 2012 to 2015 (calculated with elliptical area), plus the number of new clumps; compared to the total number of clumps (including existing, dead, and new clumps). Percent of clumps with positive growth rate shown in parentheses.

[3] Column represents the number of live clumps with positive growth rate from 2012 to 2015 (calculated with elliptical volume), plus the number of new clumps; compared to the total number of clumps (including existing, dead, and new clumps). Percent of clumps with positive growth rate shown in parentheses.

[4] Column lists the average growth rate from 2012 to 2015 (calculated using elliptical area) of existing clumps. The calculation does not include dead or new clumps.

[5] Column lists the average growth rate from 2012 to 2015 (calculated using elliptical volume) of existing clumps. The calculation does not include dead or new clumps.

[6] Clumps 1235, 1244, and 1251 from Monitoring Plot I, and clump 1187 from Monitoring Plot J could not be included in calculation due to lack of height and width data from Tetra Tech. These clumps were mapped in 2012, but height and width data were displayed as zero for these clumps.

The ratio of clumps with a positive growth rate was calculated for each plot previously monitored (Table 3-2). A total of 104 clumps in 10 monitoring plots were analyzed. It was not possible to analyze plots R through W because they were newly established, or plot C because the single clump that existed in 2012 had since split into two clumps. New and dead clumps were included in the calculation. Combined and split clumps were excluded from the calculation. Overall, roughly one-third of the clumps were new or saw positive growth, while two-thirds were either lost or decreased in size since 2012. Plots I, J, and N saw the most positive growth, while plots H, P, and Q experienced the most negative growth. Growth rates for elliptical area ranged

from zero in Plot O to 63.6 percent in Plot I. Growth rates for elliptical volume ranged from zero in Plot O to 54.5 percent in Plot J.

The average growth rate was calculated for each plot using only clump data that were directly comparable to data from 2012 (Table 3-2). Combined, split, new, and dead clumps were excluded from this calculation. Growth rate was calculated using both elliptical area and volume for each clump. The raw average growth rate of the 84 clumps is not a reliable indicator of actual growth because of a select few clumps with extremely high growth rates skewing the data; therefore, it will not be discussed in this report.

As an alternative, the ratio (and percent) of clumps with positive growth for just the live clumps monitored in both 2012 and 2015 can be examined. This analysis is similar to the above analysis in Table 3-2 of the ratio of clumps with a positive growth rate, but excludes the lost and new clumps. When growth rate was calculated using elliptical area, 50 of the 84 clumps (60%) saw positive growth rates. Calculations using elliptical volume (instead of elliptical area), resulted in only 25 of the 84 clumps (30%) with positive growth rates; however, elliptical area is considered a better measure in this case because the taller outliers tended to skew the data.

3.3 MULTIPLE REGRESSION CALCULATIONS AND ANALYSIS

The results of the multiple regression analysis determined that only a small fraction (Adjusted Rsqr = 3.2%) of the elliptical area variance can be explained by this statistically significant model ($F=1.764$; $p=0.087$). A statistically significant positive relationship was found between drainage type and elliptical area (Beta = 10689.5, $t=2.1$, $p<0.03$) and a similar relationship between shrub cover and elliptical area (Beta = 310.3, $t= 2.1$, $p=0.04$). The positive relationships described above suggest that: (1) Willowy monardella clumps from secondary drainages are expected to have a larger elliptical area than clumps growing in primary drainages; and (2) Willowy monardella individuals with larger elliptical areas are more likely to be found in areas with higher shrub cover, while clumps with smaller elliptical areas would be prevalent in areas with lower shrub cover. The amount of bare ground, native herb cover, non-native herb cover, tree cover, residual dry matter, and herbivory were not significant predictors of elliptical area.

3.4 MONITORING DATA RESULTS

Table 3-3 provides a summary of the number of willowy monardella clumps within each life stage category.

Table 3-3
Life Stage Totals

Monitoring Plot	Seedling	Juvenile	Mature	Adult	Total
A	0	0	1	4	**5**
C	0	0	0	2	**2**
G	0	0	0	3	**3**
H	0	0	1	8	**9**
I	0	3	3	21	**27**
J	0	0	0	12	**12**
L	0	0	0	4	**4**
N	0	0	0	5	**5**
O	0	0	0	1	**1**
P	0	0	1	11	**12**
Q	0	0	0	15	**15**
R	0	1	2	10	**13**
S	0	2	0	18	**20**
T	0	1	0	9	**10**
U	0	3	0	8	**11**
V	0	0	0	21	**21**
W	1	1	0	17	**19**
Total	**1**	**11**	**8**	**169**	**189**

The majority of clumps (approximately 90%) were in the adult life stage category. Juvenile and mature clumps accounted for a combined 10 percent of the total monitored individuals. Only one seedling was observed during the surveys.

Table 3-4 provides a summary of the number of clumps in each phenological state within each monitoring plot. Over half (approximately 53%) of the monitored individuals were seeding, while 36.5 percent were flowering. Only 10 percent of individuals were vegetative, and only one individual was budding.

Table 3-5 provides a summary of the number of clumps with no RDM, minimal RDM, and dense thatch. The majority of clumps (63.5%) were surrounded by minimal RDM. A single clump was surrounded by dense thatch, while the remaining clumps had no RDM surrounding them.

Table 3-4
Phenological Stage Totals

Monitoring Plot	Vegetative	Budding	Flowering	Seeding	Total
A	3	0	0	2	**5**
C	0	0	0	2	**2**
G	1	0	1	1	**3**
H	0	0	3	6	**9**
I	1	0	11	15	**27**
J	2	0	4	6	**12**
L	0	0	3	1	**4**
N	0	0	5	0	**5**
O	0	0	0	1	**1**
P	0	0	3	9	**12**
Q	5	0	6	4	**15**
R	2	0	8	3	**13**
S	2	0	14	4	**20**
T	0	1	2	7	**10**
U	0	0	4	7	**11**
V	1	0	2	18	**21**
W	2	0	3	14	**19**
Total	**19**	**1**	**69**	**100**	**189**

Table 3-5
Residual Dry Matter (RDM) Results

Monitoring Plot	No RDM	Minimal RDM	Dense Thatch	Total
A	0	5	0	**5**
C	0	2	0	**2**
G	1	2	0	**3**
H	0	9	0	**9**
I	11	16	0	**27**
J	4	8	0	**12**
L	4	0	0	**4**
N	5	0	0	**5**
O	1	0	0	**1**
P	6	5	1	**12**
Q	8	7	0	**15**
R	9	4	0	**13**
S	10	10	0	**20**
T	3	7	0	**10**
U	2	9	0	**11**
V	1	20	0	**21**
W	3	16	0	**19**
Total	**68**	**120**	**1**	**189**

Table 3-6 provides a summary of the number of individual clumps in each location category indicating relative position within the drainages.

Table 3-6
Number of Clumps within each Drainage Position

Monitoring Plot	Drainage Type	Drainage Position						Total
		1. Drainage Channel Bottom	2. Meandering Drainage Bank	3. Alluvial Benches/ Flats	1,3[1]	2,3[2]	1,2,3[3]	
A	Secondary	0	0	4	0	1	0	**5**
C	Secondary	0	0	2	0	0	0	**2**
G	Primary	0	0	1	0	2	0	**3**
H	Primary	0	0	9	0	0	0	**9**
I	Secondary	7	2	12	3	2	1	**27**
J	Secondary	4	2	6	0	0	0	**12**
L	Secondary	1	2	0	0	1	0	**4**
N	Secondary	3	0	1	0	1	0	**5**
O	Secondary	1	0	0	0	0	0	**1**
P	Primary	1	0	10	0	1	0	**12**
Q	Primary	0	1	14	0	0	0	**15**
R	Secondary	9	1	2	1	0	0	**13**
S	Secondary	6	0	14	0	0	0	**20**
T	Secondary	1	0	8	0	1	0	**10**
U	Primary	8	0	3	0	0	0	**11**
V	Secondary	20	0	1	0	0	0	**21**
W	Primary	10	0	9	0	0	0	**19**
Total		**71**	**8**	**96**	**4**	**9**	**1**	**189**

[1] Clumps were located partially within main drainage, and partially inside edge of curve in meandering drainages.
[2] Clumps were located partially inside edge of curve in meandering drainages, and partially on alluvial benches/ flats.
[3] Clump was located partially within main drainage, partially inside edge of curve in meandering drainages, and partially on alluvial benches/ flats.

Approximately half of the clumps were growing on alluvial benches/ flats. The majority of the remaining clumps (37.6%) were growing within the drainage channel bottom. Only eight clumps were growing on a meandering drainage bank, and 14 clumps were partially located in one of the three combinations displayed above.

3.5 PHOTOGRAPHIC COMPARISON

Table 3-7 summarizes the photographic comparison of the 11 preestablished monitoring plots. Monitoring plot photographs can be found in Appendix E.

Table 3-7
Photographic Comparison

Monitoring Plot I.D.	Comparison Observations
A	Flat-top buckwheat (*Eriogonum fasciculatum*) and non-native grasses appear drier in 2015 than in 2012.
C	There is currently substantially less non-native grass cover than in 2012.
G	Flat-top buckwheat and non-native grasses appear drier in 2015 than in 2012. Broom baccharis (*Baccharis sarothroides*) has sprouted in the drainage.
H	Non-native grasses appear drier in 2015 than in 2012.
I	Willowy monardella clumps appear smaller and drier in 2015 than in 2012. Non-native grass cover appears to have decreased.
J	Flat-top buckwheat and poison oak (*Toxicodendron diversilobum*) appear to be much drier than in 2012. Non-native grass cover has decreased.
L	Flat-top buckwheat and non-native grasses appear drier in 2015 than in 2012.
N	Cottonbatting plant (*Pseudonaphalium stramineum*) appears to have migrated from the alluvial bench into the drainage. Non-native grasses are drier and have decreased in cover since 2012.
O	Felt-leaf yerba santa (*Eriodictyon crassifolium*), poison oak, and non-native grasses appear drier than in 2012.
P	Non-native grass appears drier and has decreased in cover since 2012.
Q	Non-native grass appears drier and has decreased in cover since 2012. Short-pod mustard (*Hirschfeldia incana*) is currently present; however, it is hard to determine its presence in the photograph from 2012.

Generally, vegetation appeared drier than during the previous monitoring event. This could be due to drought conditions discussed in Section 3.6 below. Non-native grass cover has decreased since the previous monitoring event. Overall, shrub and tree cover appeared to have little to no change since the previous monitoring event.

3.6 RAINFALL DATA

The historical rainfall average at MCAS Miramar is 10.23 inches. This is based on data available from the San Diego County Department of Public Works (2015) and Western Regional Climate Center (2015).

For the last 16 seasons (July 1 to June 30), there have been only three seasons with above average rainfall. The 2014–2015 season was the fourth season in a row with significantly below normal rainfall (8.05 inches), with 2013–2014 as one of the lowest seasons on record (3.91 inches).

In addition to drought conditions during the willowy monardella monitoring surveys, rain was distributed abnormally during the season. While the 1.44 inches in May 2015 assisted in

preventing the drying of the plants, it was later than the normal growing season for plants to generate flowering and new growth. Until the rainfall in May 2015, the precipitation was only 65 percent of normal.

This page intentionally left blank.

CHAPTER 4
DISCUSSION

4.1 OBSERVED TRENDS

4.1.1 Clump Growth, Mortality, and Recruitment

Overall, willowy monardella growth has been minimal since 2012; however, close to two-thirds (60%) of clumps monitored in 2012 that survived to the 2015 monitoring period saw positive growth rates, while slightly more than one-third of clumps decreased in size during this period. When dead clumps and new clumps are included in the analysis, only one-third of clumps were new or saw positive growth, while two-thirds were either lost or decreased in size since 2012. Height growth appears to have slowed or decreased more so than prostrate growth since 2012. This is evident by the fact that for all previously monitored and new clumps (including dead clumps), approximately 10 percent fewer clumps saw positive growth when using elliptical volume rather than elliptical area to calculate growth rate. For clumps previously monitored in 2012 that survived to 2015, the number of clumps that experienced positive growth using elliptical volume was only half of the number of clumps that experienced positive growth using elliptical area. This result is not unexpected, however, if clumps tend to reach a stable height as adults while continuing to expand horizontally outward.

Recruitment appears to have remained low since the last monitoring event with approximately 90 percent of clumps in the adult life stage category. Juvenile and mature clumps accounted for a combined 10 percent of the total monitored individuals, and only one seedling was observed during the surveys. The low levels of willowy monardella recruitment and clump growth since the last monitoring period are most likely attributed to the low amount of rainfall received. MCAS Miramar has experienced drought conditions over the last 4 years with 2013–2014 as one of the driest seasons on record.

4.1.2 Regression Analysis

The results of the multiple regression and growth rate analyses indicated that secondary drainages (i.e., tributaries to primary drainages) contained the largest clumps and had a greater number of individuals with positive growth, while primary drainages contained smaller clumps and had fewer individuals with positive growth. Secondary drainages also had a higher percentage of clumps in the bottom of the drainage channel (approximately half) compared with primary drainages, which had a little more than a third of the clumps in the channel bottom with

the remainder occurring on alluvial benches or along the meander bank. However, the correlation between positive growth and drainage type could be due to any number of physical or biological conditions unique to the specific drainages involved.

The results of the multiple regression analysis also indicated that clumps with a higher amount of shrub cover within the 5-foot quadrats were larger than clumps with a lower amount of shrub cover. Although a causal relationship cannot be assumed, it is possible that willowy monardella growth responds positively to neighboring shrubs, perhaps through increased soil fertility generated by neighboring root systems, beneficial mycorrhizal networks increasing water and mineral nutrient absorption, the beneficial effects of shading on drought stressed individuals, or other factors. Alternatively, it is possible that the microenvironment in quadrats with both larger willowy monardella clumps and neighboring shrubs had physical conditions such as soil texture, slope position, soil chemistry, or soil moisture that were more favorable to shrub growth for multiple species.

4.1.3 Herbivory

The majority of willowy monardella plants showed no signs of herbivory to their stems or leaves. Only a single clump was observed to be top-foraged by a rabbit. Herbivory observations differed from the observations made in 2012, when it was reported that top-foraged willowy monardella individuals were a "common observation" (Tetra Tech 2013b). However, during the 2015 monitoring, micro moth larvae were found within the seed heads of numerous plants in all monitoring plots. Evidence of seed herbivory was observed with the majority of seeds being damaged and a presence of caterpillar excrement in the affected heads. A photograph of a moth larva found within a seed head can be seen in Appendix D. Very few seeds were found within the flowers containing moth larvae, and those heads had abundant frass or excrement from the feeding caterpillars. This could have a significant negative effect on germination and establishment of new willowy monardella individuals. It is difficult to tell whether the seed herbivory is a new concern since the previous monitoring event, as the seed heads need to be checked to observe whether seed predation is occurring. It is not known whether previous surveyors checked seed heads for seed herbivory.

4.1.4 Pollinators

Several different types of insect pollinators were observed nectaring on willowy monardella, including Behr's metalmark (*Apodemia virgulti virgulti)*, woodland skipper (*Ochlodes sylvanoides*), and a Bembicid wasp (probably genus *Steniola*). Photographs of pollinators are presented in Appendix D.

4.1.5 Disturbance

The monitoring plots saw minimal disturbance. The majority of disturbance was noted in plots R, S, and T located in Spring Canyon, as well as plot W, located in Sycamore Canyon; where human activity due to recreational trail use was prominent. Plot W had the highest number of clumps with missing tags, and it appeared someone had gone in and removed them.

Although non-native grasses were present in some of the plots, when comparing photographs from the 2012 surveys to photographs from 2015, it was noted that non-native grass cover has decreased substantially. Additionally, non-native grass cover within the 1-foot quadrats around all of the willowy monardella clumps was negligible (less than 2 percent). Also of note is that the majority of willowy monardella were surrounded by minimal or no dried thatch or RDM. A single clump was surrounded by dense thatch.

The lack of weed cover and RDM reflects the lack of soil churning disturbance, although recreational foot traffic and trail use was evident within some of the plots. Lack of weed cover may be due to low soil fertility and drought conditions over the last several years. Additionally, MCAS Miramar biologists have been mechanically controlling the herbaceous plant cover within a radius around the willowy monardella clumps for the past 5 years.

4.2 CONCLUSION

Overall, the willowy monardella population on East Miramar, as well as size of individual clumps, appears to have decreased since 2012. This is evident by the fact that nine out of 12 monitoring plots saw 50 percent or greater willowy monardella clumps with negative growth rates between 2012 and 2015. Additionally, the monitoring plots lost a total of 38 clumps, while only 16 new clumps were recorded since 2012.

The mortality and general decrease in clump size could be because rainfall during the 2014–2015 season was only 65 percent of the average for the area and that MCAS Miramar has experienced drought conditions over the last 4 years with 2013–2014 as one of the driest seasons on record. Although human recreational activity was evident in some of the monitoring plots, none of the plants appeared to be trampled or impacted from the disturbance. Also, the plants did not appear to be competing for resources as there was low cover of non-native weeds in most plots.

This page intentionally left blank.

CHAPTER 5
REFERENCES

Marine Corps Air Station Miramar (MCAS Miramar). 2011. Integrated Natural Resources Management Plan. Available at http://www.miramar-ems.marines.mil/Divisions/NaturalResourcesDivision/NaturalResources.aspx.

San Diego County Department of Public Works Miramar MCAS Monthly, Rainfall in inches: Site 1840. San Diego County Flood Control District, County of San Diego, Department of Public Works. 5500 Overland Ave. Suite 310. Unpublished report 08/31/2015.

Tetra Tech, Inc. (Tetra Tech). 2013a. *Willowy Monardella (Monardella viminea) Field Protocol Manual*.

Tetra Tech, Inc. (Tetra Tech). 2013b. *Willowy Monardella (Monardella viminea) Census and Monitoring Surveys Final Report*.

U.S. Fish and Wildlife Service (USFWS). 1996. Final Rule. Endangered and Threatened Wildlife and Plants; Determination of Endangered or Threatened Status for Four Southern Maritime Chaparral Plant Taxa from Coastal Southern California and Northwestern Baja California, Mexico. 50 CFR Part 17, FR 52370-52384.

Western Regional Climate Center. 2015. Available at http://www.wrh.noaa.gov/sgx/obs/rtp/miramar.html. Accessed August 30.

This page intentionally left blank.

APPENDIX A

Field Data Sheets for Monitoring Plots

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: A

Drainage Mapped: No

Date: 7/15/2015

Surveyors: Jenna Harstook, John Messina

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	5	Number of Vegetative Individuals	3
Number of Adults	4	Number of Blooming Individuals	0
Number of Mature Individuals	1	Number of Flowering Individuals	0
Number of Juvenile Individuals	0	Number of Seeding Individuals	2
Number of Seedlings	0	Number of Dead/Dormant	0

Disturbance Observations (type of disturbance, severity, and frequency):

None

Depth of Drainage (centimeters, cm): 18

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 3

Aspect: 225

General Observations:

Replaced SW corner stake, SE corner stake is hidden by an overgrown tree.

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Rhamnus	crocea	10	Erodium	botrys	20
Eriogonum	fasciculatum	15	Avena	barbata	20

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: C

Drainage Mapped: No

Date: 7/16/2015

Surveyors: Bonnie Hendricks, Jenna Harstook

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	2	Number of Vegetative Individuals	0
Number of Adults	2	Number of Blooming Individuals	0
Number of Mature Individuals	0	Number of Flowering Individuals	0
Number of Juvenile Individuals	0	Number of Seeding Individuals	2
Number of Seedlings	0	Number of Dead/Dormant	0

Disturbance Observations (type of disturbance, severity, and frequency):

None

Depth of Drainage (centimeters, cm): 80

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 7

Aspect: 100

General Observations:

Weed cover is lower when compared with previous plot photo. No disturbance evident.

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Rhamnus	crocea	5	Erodium	botrys	10
Eriogonum	fasciculatum	15	Bromus	diandrus	10
Eriodictyon	crassifolia	5			0

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: G

Drainage Mapped: No

Date: 7/16/2015

Surveyors: Bonnie Hendricks, Jenna Harstook

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	3	Number of Vegetative Individuals	1
Number of Adults	3	Number of Blooming Individuals	0
Number of Mature Individuals	0	Number of Flowering Individuals	1
Number of Juvenile Individuals	0	Number of Seeding Individuals	1
Number of Seedlings	0	Number of Dead/Dormant	2

Disturbance Observations (type of disturbance, severity, and frequency):

Road goes through part of plot.

Depth of Drainage (centimeters, cm): 40

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 10

Aspect: 90

General Observations:

Cobbles on bench.

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Salvia	apiana	5	Erodium	botrys	5
Eriogonum	fasciculatum	10	Avena	barbata	5
Circocarpus	minutiflorus	10	Bromus	diandrus	15

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: H

Drainage Mapped: No

Date: 7/15/2015

Surveyors: Jenna Harstook, John Messina

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	9	Number of Vegetative Individuals	0
Number of Adults	8	Number of Blooming Individuals	0
Number of Mature Individuals	1	Number of Flowering Individuals	3
Number of Juvenile Individuals	0	Number of Seeding Individuals	6
Number of Seedlings	0	Number of Dead/Dormant	7

Disturbance Observations (type of disturbance, severity, and frequency):

None

Depth of Drainage (centimeters, cm): 26

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 6

Aspect: 270

General Observations:

None

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Rhamnus	crocea	15	Avena	barbata	40
		0	Bromus	diandrus	55

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: I

Drainage Mapped: No

Date: 7/17/2015

Surveyors: Jenna Harstook, Sundeep Amin

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	27	Number of Vegetative Individuals	1
Number of Adults	21	Number of Blooming Individuals	0
Number of Mature Individuals	3	Number of Flowering Individuals	11
Number of Juvenile Individuals	3	Number of Seeding Individuals	15
Number of Seedlings	0	Number of Dead/Dormant	0

Disturbance Observations (type of disturbance, severity, and frequency):

None

Depth of Drainage (centimeters, cm): 40

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 11

Aspect: 30

General Observations:

None

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Rhamnus	crocea	5	Erodium	botrys	5
Eriogonum	fasciculatum	25	Bromus	madritensis	7

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: J

Drainage Mapped: No

Date: 7/17/2015

Surveyors: Jenna Harstook, Sundeep Amin

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	12	Number of Vegetative Individuals	2
Number of Adults	12	Number of Blooming Individuals	0
Number of Mature Individuals	0	Number of Flowering Individuals	4
Number of Juvenile Individuals	0	Number of Seeding Individuals	6
Number of Seedlings	0	Number of Dead/Dormant	0

Disturbance Observations (type of disturbance, severity, and frequency):

some non-native grasses within plot.

Depth of Drainage (centimeters, cm): 40

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 12

Aspect: 190

General Observations:

None

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Rhamnus	crocea	5	Bromus	madritensis	10
Prunus	ilicifolia	3			0
Eriogonum	fasciculatum	15			0
Eriodictyon	crassifolia	5			0

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: L

Drainage Mapped: No

Date: 7/16/2015

Surveyors: Bonnie Hendricks, Jenna Harstook

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	4	Number of Vegetative Individuals	0
Number of Adults	4	Number of Blooming Individuals	0
Number of Mature Individuals	0	Number of Flowering Individuals	3
Number of Juvenile Individuals	0	Number of Seeding Individuals	1
Number of Seedlings	0	Number of Dead/Dormant	0

Disturbance Observations (type of disturbance, severity, and frequency):

Minimal disturbance. Non-native grasses within plot.

Depth of Drainage (centimeters, cm): 40

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 8

Aspect: 100

General Observations:

3 pollinators observed; black and yellow wasp, small bee fly, and skipper.

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Rhamnus	crocea	5	Bromus	diandrus	50
Quercus	acutidens	10	Erodium	botrys	10
Prunus	ilicifolia	5			0
Eriogonum	fasciculatum	8			0

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: N

Drainage Mapped: No

Date: 7/15/2015

Surveyors: Jenna Harstook, John Messina

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	5	Number of Vegetative Individuals	0
Number of Adults	5	Number of Blooming Individuals	0
Number of Mature Individuals	0	Number of Flowering Individuals	5
Number of Juvenile Individuals	0	Number of Seeding Individuals	0
Number of Seedlings	0	Number of Dead/Dormant	5

Disturbance Observations (type of disturbance, severity, and frequency):

None

Depth of Drainage (centimeters, cm): 25

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 5

Aspect: 75

General Observations:

Replaced SW corner stake; SE corner is delineated by blue spray paint on rocks (actual corner is within large poison oak bush).

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Eriogonum	fasciculatum	15	Erodium	botrys	25
Cercocarpus	minutiflorus	10	Bromus	diandrus	35

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: O

Drainage Mapped: No

Date: 7/15/2015

Surveyors: Jenna Harstook, John Messina

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	1	Number of Vegetative Individuals	0
Number of Adults	1	Number of Blooming Individuals	0
Number of Mature Individuals	0	Number of Flowering Individuals	0
Number of Juvenile Individuals	0	Number of Seeding Individuals	1
Number of Seedlings	0	Number of Dead/Dormant	0

Disturbance Observations (type of disturbance, severity, and frequency):

None

Depth of Drainage (centimeters, cm): 30

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 4

Aspect: 117

General Observations:

None

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Cercocarpus	minutiflorus	10	Bromus	diandrus	85

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: P

Drainage Mapped: No

Date: 7/14/2015

Surveyors: Bonnie Hendricks, Jenna Harstook, John Messina

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	12	Number of Vegetative Individuals	0
Number of Adults	11	Number of Blooming Individuals	0
Number of Mature Individuals	1	Number of Flowering Individuals	3
Number of Juvenile Individuals	0	Number of Seeding Individuals	9
Number of Seedlings	0	Number of Dead/Dormant	3

Disturbance Observations (type of disturbance, severity, and frequency):

high amount of non-native grasses, historic fire scars present

Depth of Drainage (centimeters, cm): 50

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 1

Aspect: 270

General Observations:

wasps seen pollinating a few of the monardella plants

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Eriogonum	fasciculatum	20	Bromus	diandrus	15
Baccharis	sarothroides	10	Erodium	sp.	10
Ambrosia	psilostachya	10	Avena	barbata	15

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: Q

Drainage Mapped: No

Date: 7/14/2015

Surveyors: Bonnie Hendricks, Jenna Harstook, John Messina

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	15	Number of Vegetative Individuals	5
Number of Adults	15	Number of Blooming Individuals	0
Number of Mature Individuals	0	Number of Flowering Individuals	6
Number of Juvenile Individuals	0	Number of Seeding Individuals	4
Number of Seedlings	0	Number of Dead/Dormant	2

Disturbance Observations (type of disturbance, severity, and frequency):

Mustard invasion in area of soil disturbance from gopher activity

Depth of Drainage (centimeters, cm): 45

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 2

Aspect: 225

General Observations:

None

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Eriogonum	fasciculatum	15	Erodium	botrys	25
		0	Avena	barbata	15
		0	Hirschfeldia	incana	10

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: R

Drainage Mapped: No

Date: 7/20/2015

Surveyors: Jenna Harstook, Sundeep Amin

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	13	Number of Vegetative Individuals	2
Number of Adults	10	Number of Blooming Individuals	0
Number of Mature Individuals	2	Number of Flowering Individuals	8
Number of Juvenile Individuals	1	Number of Seeding Individuals	3
Number of Seedlings	0	Number of Dead/Dormant	4

Disturbance Observations (type of disturbance, severity, and frequency):

Recreational hiking/ bicycle trail runs through plot. Non-native grasses in open areas of plot.

Depth of Drainage (centimeters, cm): 37

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 18

Aspect: 20

General Observations:

None

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Quercus	xacutidens	5	Avena	barbata	15
Heteromeles	arbutifolia	3	Bromus	diandrus	15
Eriogonum	facsiculatum	3			0
Circocarpus	minutiflora	5			0

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: S

Drainage Mapped: No

Date: 7/17/2015

Surveyors: Jenna Harstook, Sundeep Amin

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	20	Number of Vegetative Individuals	2
Number of Adults	18	Number of Blooming Individuals	0
Number of Mature Individuals	0	Number of Flowering Individuals	14
Number of Juvenile Individuals	2	Number of Seeding Individuals	4
Number of Seedlings	0	Number of Dead/Dormant	1

Disturbance Observations (type of disturbance, severity, and frequency):

Recreational hiking/ bicycle trail runs through plot.

Depth of Drainage (centimeters, cm): 42

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 14

Aspect: 200

General Observations:

None

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Prunus	ilicifolia	3	Erodium	botrys	5
Heteromeles	arbutifolia	5	Bromus	diandrus	5
Eriogonum	fasciculatum	35			0
Baccharis	sarothroides	3			0

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: T

Drainage Mapped: No

Date: 7/17/2015

Surveyors: Jenna Harstook, Sundeep Amin

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	10	Number of Vegetative Individuals	0
Number of Adults	9	Number of Blooming Individuals	1
Number of Mature Individuals	0	Number of Flowering Individuals	2
Number of Juvenile Individuals	1	Number of Seeding Individuals	7
Number of Seedlings	0	Number of Dead/Dormant	1

Disturbance Observations (type of disturbance, severity, and frequency):

A recreational bicycle/ hiking trail runs through plot. Non-native grasses within plot.

Depth of Drainage (centimeters, cm): 20

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 15

Aspect: 160

General Observations:

None

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Rhamnus	crocea	5	Erodium	botrys	5
Prunus	ilicifolia	7	Bromus	diandrus	7
Eriogonum	fasciculatum	30	Avena	barbata	10

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: U

Drainage Mapped: No

Date: 7/20/2015

Surveyors: Jenna Harstook, Sundeep Amin

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	11	Number of Vegetative Individuals	0
Number of Adults	8	Number of Blooming Individuals	0
Number of Mature Individuals	0	Number of Flowering Individuals	4
Number of Juvenile Individuals	3	Number of Seeding Individuals	7
Number of Seedlings	0	Number of Dead/Dormant	9

Disturbance Observations (type of disturbance, severity, and frequency):

plot runs adjacent to recreational bicycle/ hiking trail. Signs of dear use within plot (pellets).

Depth of Drainage (centimeters, cm): 65

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 19

Aspect: 175

General Observations:

None

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Salvia	apiana	5	Hirschfeldia	incana	5
Rhamnus	crocea	5	Bromus	madritensis	5
Eriogonum	fasciculatum	20	Lepidium	sp.	7

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: V

Drainage Mapped: No

Date: 7/20/2015

Surveyors: Jenna Harstook, Sundeep Amin

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	21	Number of Vegetative Individuals	1
Number of Adults	21	Number of Blooming Individuals	0
Number of Mature Individuals	0	Number of Flowering Individuals	2
Number of Juvenile Individuals	0	Number of Seeding Individuals	18
Number of Seedlings	0	Number of Dead/Dormant	1

Disturbance Observations (type of disturbance, severity, and frequency):

Recreational bicycle path runs through western side of plot. Non-native grasses present on bench.

Depth of Drainage (centimeters, cm): 40

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 18

Aspect: 170

General Observations:

None

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Rhamnus	crocea	5	Erodium	botrys	5
Quercus	agrifolia	15	Bromus	diandrus	7
Eriogonum	fasciculatum	25			0
Baccharis	sarothroides	5			0

Long-Term Willowy Monardella Monitoring Data Sheet

Plot: W

Drainage Mapped: No

Date: 7/21/2015

Surveyors: Jenna Harstook

Demographic Data:

Life Stage		**Phenology**	
Number of Live Clumps	19	Number of Vegetative Individuals	2
Number of Adults	17	Number of Blooming Individuals	0
Number of Mature Individuals	0	Number of Flowering Individuals	3
Number of Juvenile Individuals	1	Number of Seeding Individuals	14
Number of Seedlings	1	Number of Dead/Dormant	3

Disturbance Observations (type of disturbance, severity, and frequency):

Dirt road runs parallel to eastern portion of plot. A receational biycle/ hiking path runs through western portion of plot. Non-native grasses invading all upland areas of plot.

Depth of Drainage (centimeters, cm): 40

Photograph Point Photo Number and Aspect (degrees, deg):

Point Photo Number: 19

Aspect: 170

General Observations:

All except 2 plant tags were missing from existing clumps.

Record the relative percent cover for all dominant native and non-native species observed within the monitoring plot with at least ten percent relative cover.

Dominant Native Species Observed		**Percent Relevant Cover**	**Dominant Non-Native Species Observed**		**Percent Relevant Cover**
Toxicodendron	diversilobum	5	Bromus	diandrus	80
Quercus	agrifolia	30			0
Platanus	racemosa	25			0
Baccharis	salicifolia	5			0

APPENDIX B

Field Data Sheets for Monitoring Clumps

Record the relative percent cover for the following vegetative classes using variable sized concentric elliptical quadrats. The quadrats will be centered over the middle of the clump and extend a specific distance beyond the clump diameter and width, as indicated below. The concentric circles are greater for the shrub and tree canopies to account for possible encroachment and shading effects from nearby plants.

Vegetative Class	Quadrat Type
Willowy monardella	1 foot greater than clump
Bare ground	1 foot greater than clump
Non-native grasses	1 foot greater than clump
Native grasses	1 foot greater than clump
Unidentifiable grasses	1 foot greater than clump
Native herbs	1 foot greater than clump
Non-native herbs	1 foot greater than clump
Shrub cover	5 feet greater than clump
Tree cover	10 feet greater than clump

Clump Tag Number	Relative Percent Cover by Vegetative Class								
	Willowy Monardella	Bare Ground	Non-native Grasses	Native Grasses	Unidentifiable Grasses	Native Herbs	Non-native Herbs	Shrub Cover	Tree Cove
100	30	68	0	0	0	0	0	10	0
105	44	55	0	0	0	0	1	35	0
111	35	64	0	0	0	1	0	1	25
1173	70	29	0	0	0	0	1	15	0
1174	35	62	0	0	0	2	1	2	0
1176	25	75	0	0	0	0	0	2	0
1179	30	70	0	0	0	0	0	3	0
1180	20	79	1	0	0	0	0	1	0
1181	10	90	0	0	0	0	0	60	0
1182	30	69	0	0	0	0	1	5	0
1184	25	75	0	0	0	0	0	10	0
1186	15	85	0	0	0	0	0	20	0
1187	65	44	0	0	0	0	1	30	0
119	15	83	0	0	0	0	0	30	0
122	25	75	0	0	0	0	0	15	0
1230	25	74	0	0	0	1	0	2	0
1231	10	90	0	0	0	0	0	2	0
1232	7	92	1	0	0	0	0	5	0
1233	40	59	0	0	0	0	1	7	0
1235	7	93	0	0	0	0	0	3	0
1236	2	97	0	0	0	0	1	15	0

Clump Tag Number	Relative Percent Cover by Vegetative Class								
	Willowy Monardella	Bare Ground	Non-native Grasses	Native Grasses	Unidentifiable Grasses	Native Herbs	Non-native Herbs	Shrub Cover	Tree Cove
1237	50	50	0	0	0	0	0	10	0
1238	65	35	0	0	0	0	0	5	0
124	10	89	0	0	0	1	0	10	0
1243	20	80	0	0	0	0	0	15	0
1244	10	90	0	0	0	0	0	3	0
1246	5	95	0	0	0	0	0	5	0
1250	30	70	0	0	0	0	0	15	0
1251	60	40	0	0	0	0	0	15	0
1252	50	50	0	0	0	0	0	5	0
1253	70	30	0	0	0	0	1	3	0
1255	30	70	0	0	0	0	0	3	0
1256	35	65	0	0	0	0	0	15	0
1257	15	84	0	0	0	0	1	12	0
1258	3	97	0	0	0	0	0	7	0
1268	35	65	0	0	0	0	1	35	0
127	20	80	0	0	0	0	0	60	0
1272	30	70	0	0	0	0	0	5	0
1273	20	79	0	0	0	1	0	20	0
1279	10	90	0	0	0	0	0	10	0
128	30	70	0	0	0	0	0	15	0
1286	30	70	0	0	0	0	0	7	0
1289	10	90	0	0	0	0	0	5	0
1293	55	44	1	0	0	0	0	3	0
1295	65	35	0	0	0	0	0	10	0
1297	55	45	0	0	0	0	0	1	0
1299	40	60	0	0	0	0	0	0	0
1300	50	50	0	0	0	0	0	1	0
1307	20	80	0	0	0	0	0	0	0
1387	60	39	0	0	0	1	0	5	0
1388	45	54	0	0	0	1	0	5	0
1389	4	95	0	0	0	1	0	1	0
1390	60	37	0	0	0	3	0	4	0
1391	45		0	0	0	2	0	2	0
1393	5	95	0	0	0	0	0	55	0
1500	30	65	0	0	0	5	0	10	10

Clump Tag Number	Relative Percent Cover by Vegetative Class								
	Willowy Monardella	Bare Ground	Non-native Grasses	Native Grasses	Unidentifiable Grasses	Native Herbs	Non-native Herbs	Shrub Cover	Tree Cove
1501	7	92	0	0	0	0	1	45	0
1502	65	44	0	0	0	1	0		20
1505	5	93	2	0	0	0	0	5	0
1506	20	79	0	0	0	1	0	7	60
1520	7	92	0	0	0	1	0	0	10
1521	20		1	0	0	0	0	10	0
1524	15	84	0	0	0	0	1	0	0
1525	35	65	0	0	0	0	0	5	0
1526	5	92	0	0	0	2	1	1	0
1530	5	95	0	0	0	0	0	30	0
1541	20	80	0	0	0	0	0	0	0
1561	25	75	0	0	0	0	0	0	0
1563	30	70	1	0	0	0		5	0
1564	10	90	0	0	0	0	0	7	0
1568	5	95	0	0	0	0	0	3	0
1569	40	0	0	0	0	0	1	5	0
1570	5	93	0	0	0	0	0	25	0
1574	40	60	0	0	0	0	0	5	0
1578	10	90	0	0	0	0	0	1	0
1589	55	44	0	0	0	1	0	5	
1605	2	98	0	0	0	0	0	0	25
1614	60	40	0	0	0	0	0	20	0
1621	25	75	0	0	0	0	0	30	0
1654	25	74	0	0	0	0	1	5	0
1655	25	74	0	0	0	0	1	30	0
1656	15	82	0	0	0	0	3	30	0
1658	70	29	0	0	0	0	1	3	0
1659	5	94	0	0	0	0	1	20	0
168	20	80	0	0	0	0	0	15	0
1707	15	84	1	0	0	0	0	15	0
173	20	78	1	0	0	0	1		7
1733	15	84	0	0	0	0	1	1	0
1740	25	75	0	0	0	0	0	2	0
1752	30	68	0	0	0	1	1	0	15
1761	30	68	1	0	0	1	0	15	0

Clump Tag Number	Relative Percent Cover by Vegetative Class								
	Willowy Monardella	Bare Ground	Non-native Grasses	Native Grasses	Unidentifiable Grasses	Native Herbs	Non-native Herbs	Shrub Cover	Tree Cove
1768	25	75	0	0	0	0	0	5	0
1769	20	75	0	0	0	0	5	3	0
1770	30	69	0	0	0	1	0	25	0
1772	10	89	0	0	0		1	5	0
1774	40	60	0	0	0	0	0	25	0
1777	5	951	0	0	0	0	0	15	0
1778	30	69	0	0	0	1	0	30	0
1780	25	75	0	0	0	0	0	1	0
1834	5	95	0	0	0	0	0	3	0
1836	15	0	0	0	0	0	1	15	0
1840	5	95	0	0	0	0	0	55	0
1855	35	64	0	0	0	1	0	0	30
1857	60	39	0	0	0	1	0	10	40
1858	25	75	0	0	0	0	0	0	7
187	5	95	0	0	0	0	0	5	0
188	3	0	0	0	0	0	10	30	0
189	35	64	1	0	0	0	0	7	0
190	15	85	0	0	0	0	0	10	0
1901	60	40	0	0	0	0	0	40	0
1902	25	74	0	0	0	1	0	0	25
1905	30	67	0	0	0	0	0	7	80
1906	60	40	0	0	0	0	0	5	90
1910	7	93	0	0	0	0	0	10	10
192	65	35	0	0	0	0	0	20	0
196	35	65	0	0	0	3	0	20	0
1961	40	59	0	0	0	0	1	20	0
1984	7	93	0	0	0	0	0	40	0
1988	60	25	0	0	0	15	0	0	10
199	15	84	1	0	0	0	0	10	0
1990	5	93	0	0	0	1	1	20	40
204	7	92	0	0	0	0	1	5	0
206	7	0	0	0	0	0	1	15	0
211	50	50	0	0	0	0	0	15	0
217	10	90	0	0	0	0	0	7	0
221	7	93	0	0	0	0	0	5	0

Clump Tag Number	Relative Percent Cover by Vegetative Class								
	Willowy Monardella	Bare Ground	Non-native Grasses	Native Grasses	Unidentifiable Grasses	Native Herbs	Non-native Herbs	Shrub Cover	Tree Cove
236	25	75	0	0	0	0	0	5	0
237	10	90	0	0	0	0	0	40	0
238	10	90	0	0	0	0	0	10	0
239	10	89	0	0	0	0	1	5	0
240	25	75	0	0	0	0	0	7	0
241	40	60	0	0	0	0	1	0	0
242	7	92	1	0	0	0	0	50	0
243	20	79	0	0	0	0	1	5	0
244	65	35	0	0	0	0	0	5	0
249	20	80	0	0	0	0	1	10	0
251	10	90	0	0	0	0	0	20	0
309	20	79	0	0	0	0	1	75	0
311	10	89	0	0	0	0	0	15	0
312	10	90	0	0	0	0	0	50	0
315	3	97	0	0	0	0	0	15	0
316	3	96	0	0	0	0	1	20	0
319	15	85	0	0	0	0	0	5	0
326	25	74	0	0	0	1	0	2	0
331	25	75	0	0	0	0	0	20	0
335	20	79	0	0	0	0	1	5	0
339	15	83	0	0	0	0	2	2	0
343	5	95	0	0	0	0	0	45	0
375	30	70	0	0	0	0	0	20	0
48	25	70	1	0	0	1	3	60	0
50	65	32	2	0	0	0	1	35	15
52	30	70	0	0	0	0	0	20	0
59	25	74	0	0	0	0	1	30	0
63	25	73	1	0	0	0	1	40	0
68	30	69	0	0	0	0	0	20	0
70	15	75	0	0	0	5	0	50	25
71	15	84	0	0	0	0	0	40	5
72	10	80	0	0	0	0	0	35	5
73	25	67	0	0	0	3	0	5	0
74	10	89	0	0	0	1	0	20	0
76	20	77	0	0	0	0	3	15	0

Clump Tag Number	Relative Percent Cover by Vegetative Class								
	Willowy Monardella	Bare Ground	Non-native Grasses	Native Grasses	Unidentifiable Grasses	Native Herbs	Non-native Herbs	Shrub Cover	Tree Cove
77	20	80	0	0	0	0	0	20	0
852	25	75	0	0	0	0	0	3	0
855	15	85	0	0	0	0	0	10	0
856	20	79	0	0	0	1	0	10	0
857	40	60	0	0	0	0	0	1	0
858	10	90	0	0	0	0	0	1	0
859	70	30	0	0	0	0	0	15	0
861	60	40	0	0	0	0	0	20	0
862	60	40	0	0	0	0	0	50	0
865	50	50	0	0	0	0	0	15	0
866	10	89	0	0	0	0	1	5	0
867	60	39	0	0	0	1	0	10	0
872		0	0	0	0	0	0	0	0
873	70	29	1	0	0	0	0	25	0
874	40	58	0	0	0	0	2	5	0
875	70	30	0	0	0	0	0	45	0
876	40	59	0	1	0	0	0	5	0
905	60	40	0	0	0	0	0	10	0
919	70	30	0	0	0	0	0	5	0
920	35	65	0	0	0	0	0	20	0
921	20	79	1	0	0	0	0	65	0
924	70	29	0	0	0	1	0	5	0
925	75	24	0	0	0	1	0	0	0
926	70	26	1	0	0	1	1	1	0
927	10	89	0	0	0	0	1	5	0
931	60	40	0	0	0	0	0	15	0
932	25	74	0	0	0	0	1	5	0
934	20	80	0	0	0	0	0	30	0
935	70	30	0	0	0	0	0	25	0
99	30	68	0	0	0	0	2	10	0

APPENDIX C

Monitoring Plot Maps
(Figures 3-1 to 3-16)



Source:

100 50 0 100 Feet

Scale: 1:1,200; 1 inch = 100 feet

Figure 3-1
Willowy Monardella Monitoring Results
Willowy Monardella Monitoring Plot A

Path: \\ussdg1fp001.na.aecomnet.com\data\projects\2015\60334923_MrmrUplPlnts\900-CAD-GIS\920 GIS\922_Maps\WM_CensusPlant_Locs10_2_AllPlots.mxd, 12/16/2015, janssenn



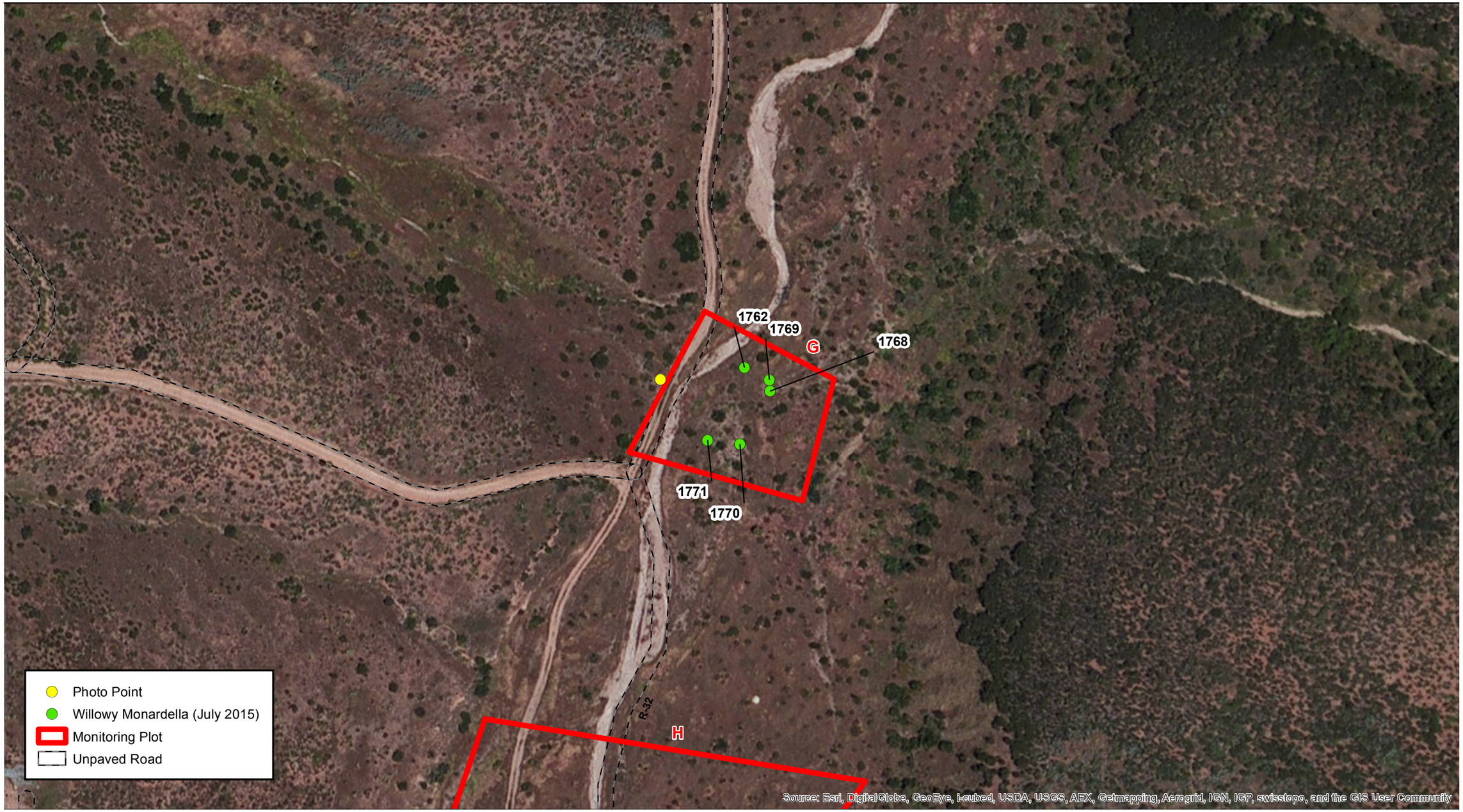
Source:

100 50 0 100 Feet

Scale: 1:1,200; 1 inch = 100 feet

Figure 3-2
Willowy Monardella Monitoring Results
Willowy Monardella Monitoring Plot C

Path: \\ussdg1fp001.na.aecomnet.com\data\projects\2015\60334923_MrmrUplPlnts\900-CAD-GIS\920 GIS\922_Maps\WM_CensusPlant_Locs10_2_Plots_N_O.mxd, 12/15/2015, janssenn



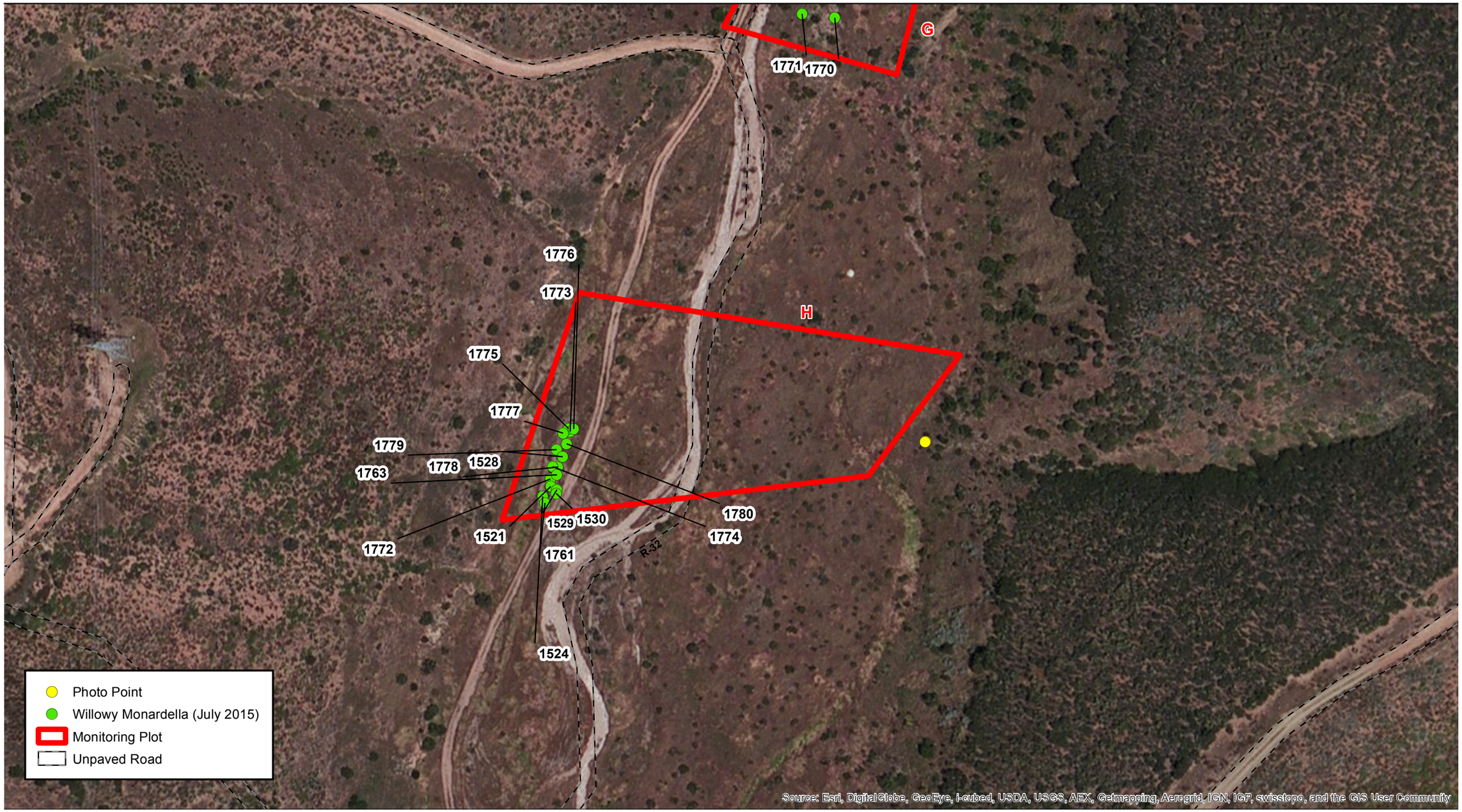
Source:

100 50 0 100 Feet

Scale: 1:1,200; 1 inch = 100 feet

Figure 3-3
Willowy Monardella Monitoring Results
Willowy Monardella Monitoring Plot G

Path: \\ussdg1fp001.na.aecomnet.com\data\projects\2015\60334923_MrmrUplPlnts\900-CAD-GIS\920 GIS\922_Maps\WM_CensusPlant_Locs10_2_Plots_N_O.mxd, 12/15/2015, janssenn



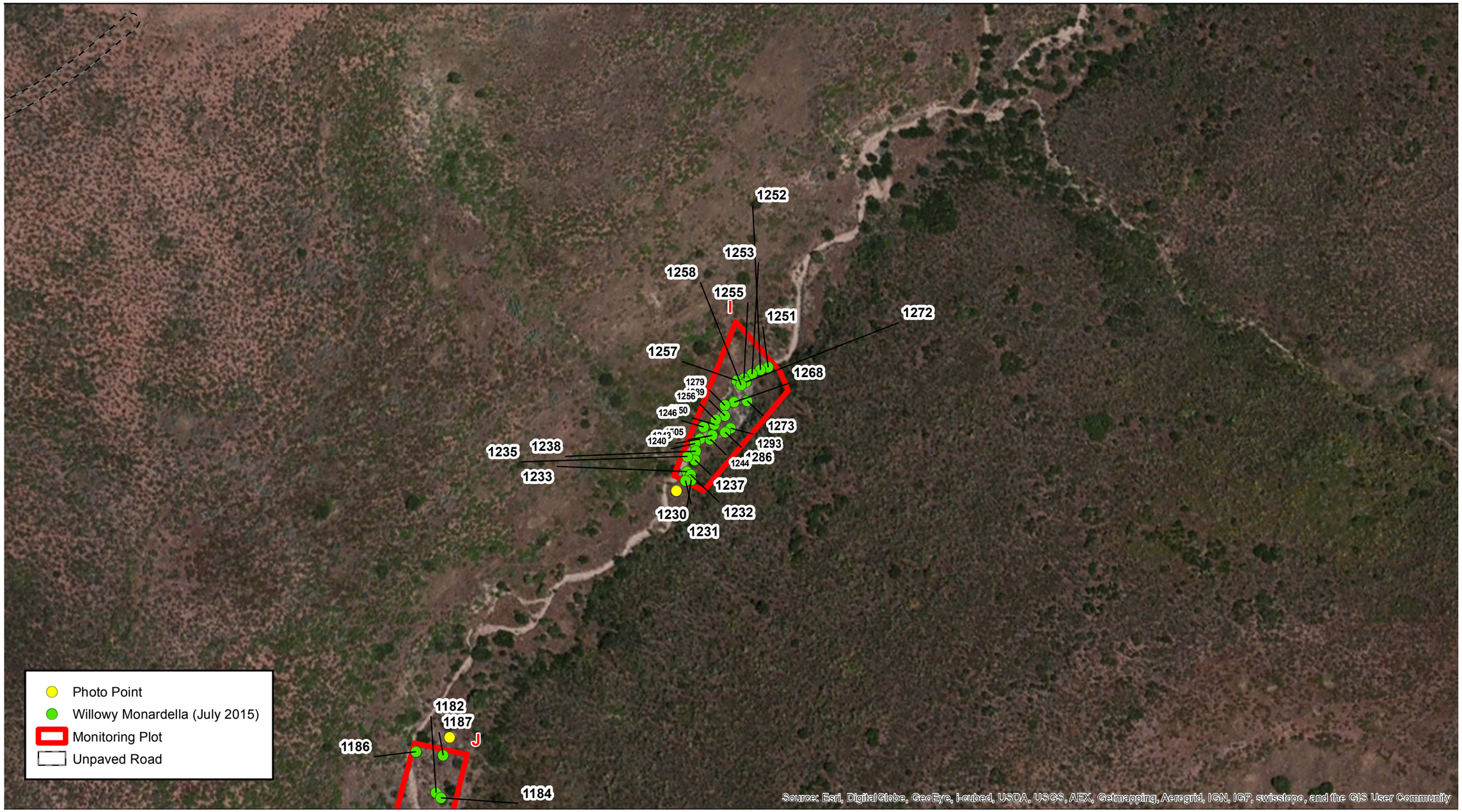
Source:

100 50 0 100 Feet

Scale: 1:1,200; 1 inch = 100 feet

Figure 3-4
Willowy Monardella Monitoring Results
Willowy Monardella Monitoring Plot H

Path: \\ussdg1fp001.na.aecomnet.com\data\projects\2015\60334923_MrmrUplPlnts\900-CAD-GIS\920 GIS\922_Maps\WM_CensusPlant_Locs10_2_Plots_N_O.mxd, 12/15/2015, janssenn



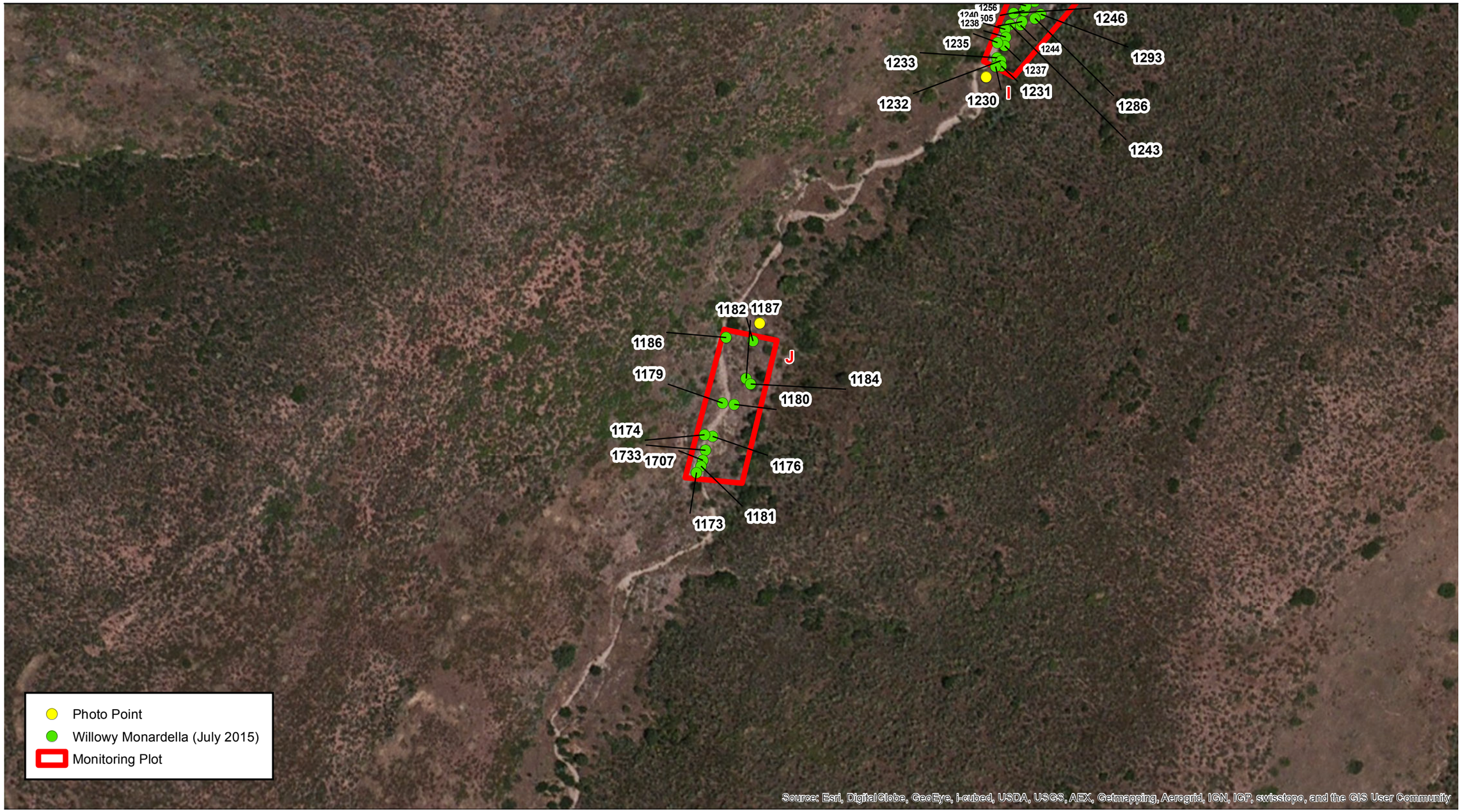
Source:

100 50 0 100 Feet

Scale: 1:1,200; 1 inch = 100 feet

Figure 3-5
Willowy Monardella Monitoring Results
Willowy Monardella Monitoring Plot I

Path: \\ussdg1fp001.na.aecomnet.com\data\projects\2015\60334923_MrmrUplPlnts\900-CAD-GIS\920 GIS\922_Maps\WM_CensusPlant_Locs10_2_Plots_N_O.mxd, 12/15/2015, janssenn



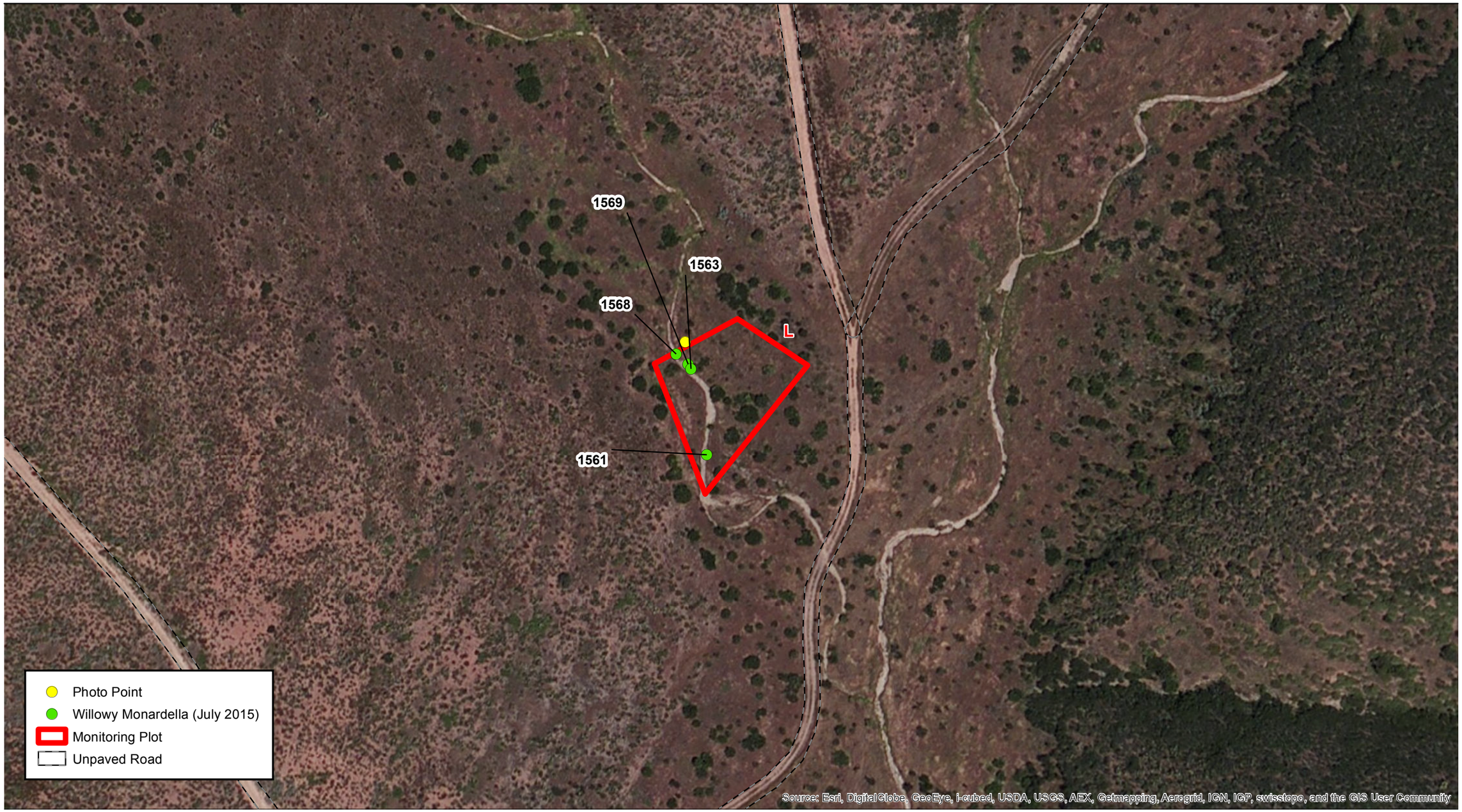
Source:

100 50 0 100 Feet

Scale: 1:1,200; 1 inch = 100 feet

Figure 3-6
Willowy Monardella Monitoring Results
Willowy Monardella Monitoring Plot J

Path: \\ussdg1fp001.na.aecomnet.com\data\projects\2015\60334923_MrmrUplPlnts\900-CAD-GIS\920 GIS\922_Maps\WM_CensusPlant_Locs10_2_Plots_N_O.mxd, 12/15/2015, janssenn



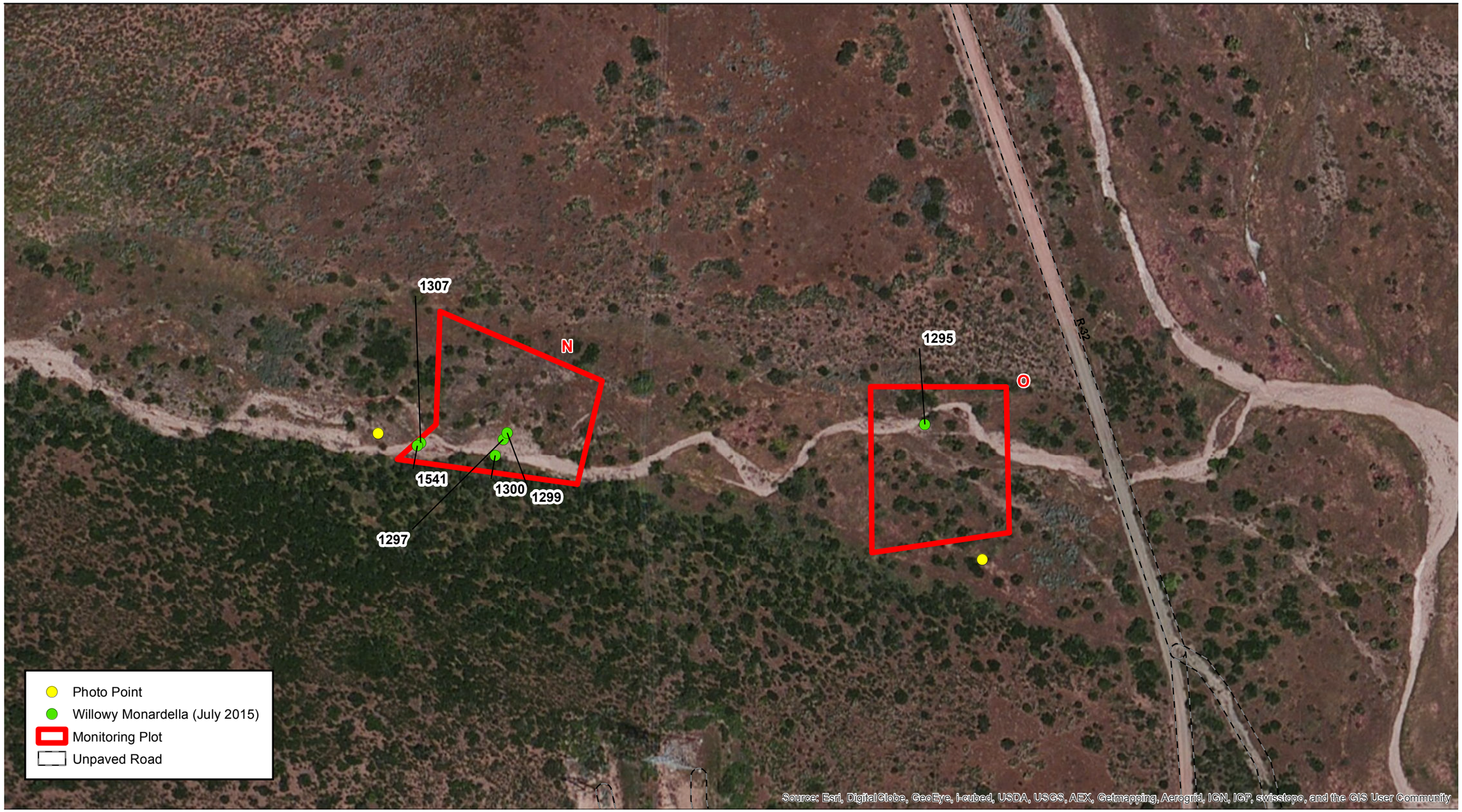
Source:

100 50 0 100 Feet

Scale: 1:1,200; 1 inch = 100 feet

Figure 3-7
Willowy Monardella Monitoring Results
Willowy Monardella Monitoring Plot L

Path: \\ussdg1fp001.na.aecomnet.com\data\projects\2015\60334923_MrmrUplPlnts\900-CAD-GIS\920 GIS\922_Maps\WM_CensusPlant_Locs10_2_Plots_N_O.mxd, 12/15/2015, janssenn



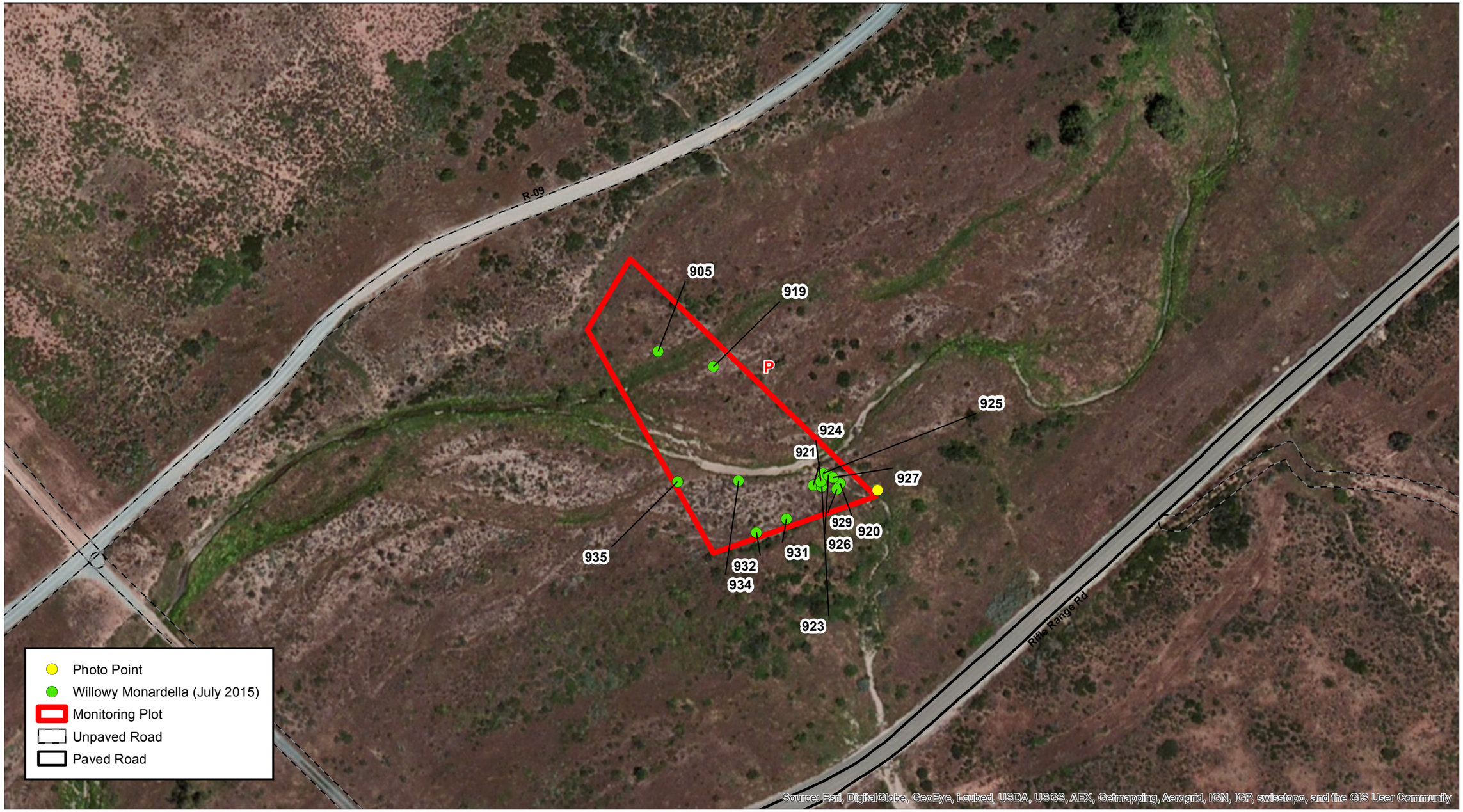
Source:

100 50 0 100 Feet

Scale: 1:1,200; 1 inch = 100 feet

Figure 3-8
Willowy Monardella Monitoring Results
Willowy Monardella Monitoring Plot N & O

Path: \\ussdg1fp001.na.aecomnet.com\data\projects\2015\60334923_MrmrUplPlnts\900-CAD-GIS\920 GIS\922_Maps\WM_CensusPlant_Locs10_2_Plots_N_O.mxd, 12/15/2015, janssenn



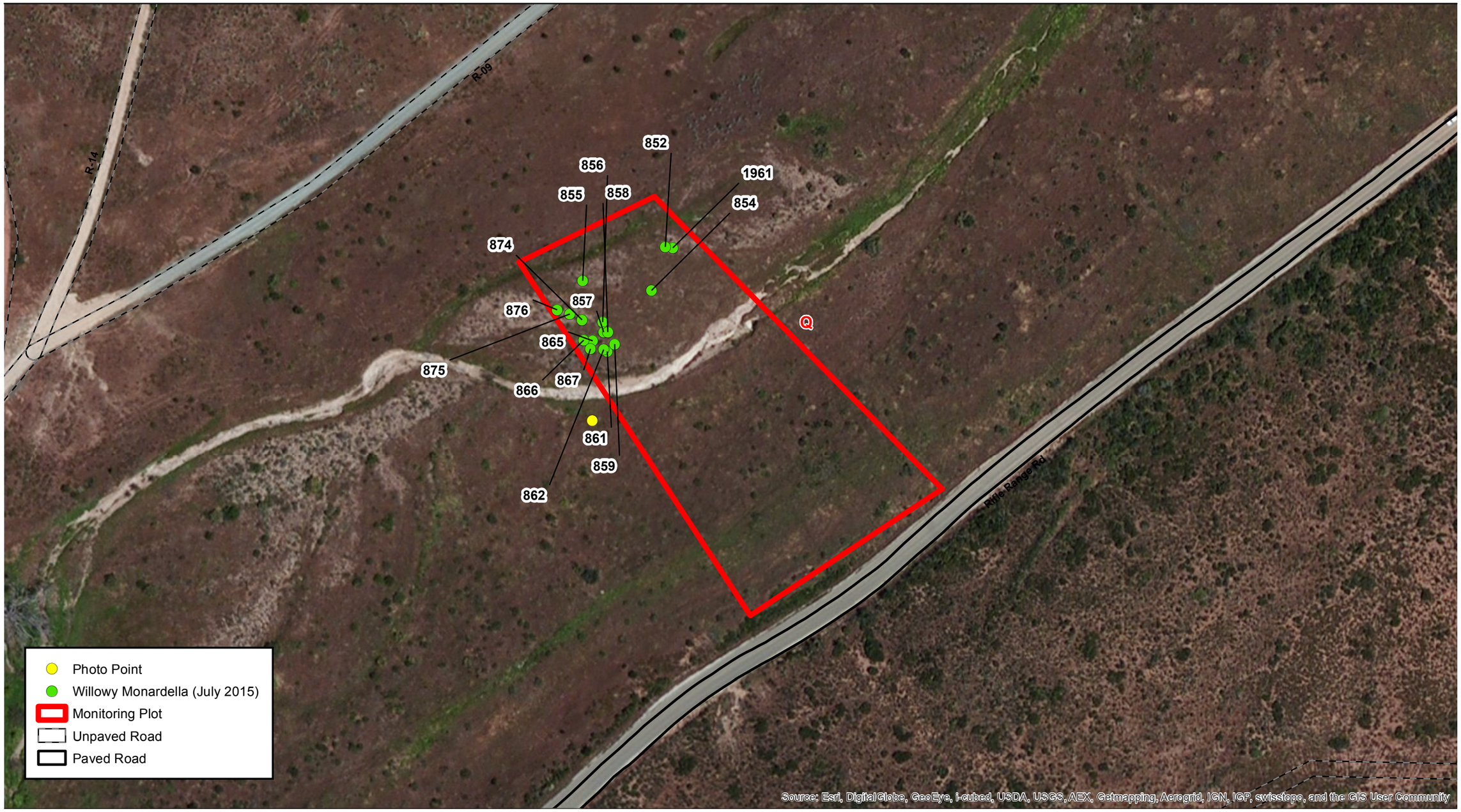
Source:

100 50 0 100 Feet

Scale: 1:1,200; 1 inch = 100 feet

Figure 3-9
Willowy Monardella Monitoring Results
Willowy Monardella Monitoring Plot P

Path: \\ussdg1fp001.na.aecomnet.com\data\projects\2015\60334923_MrmrUplPlnts\900-CAD-GIS\920 GIS\922_Maps\WM_CensusPlant_Locs10_2_Plots_N_O.mxd, 12/15/2015, janssenn



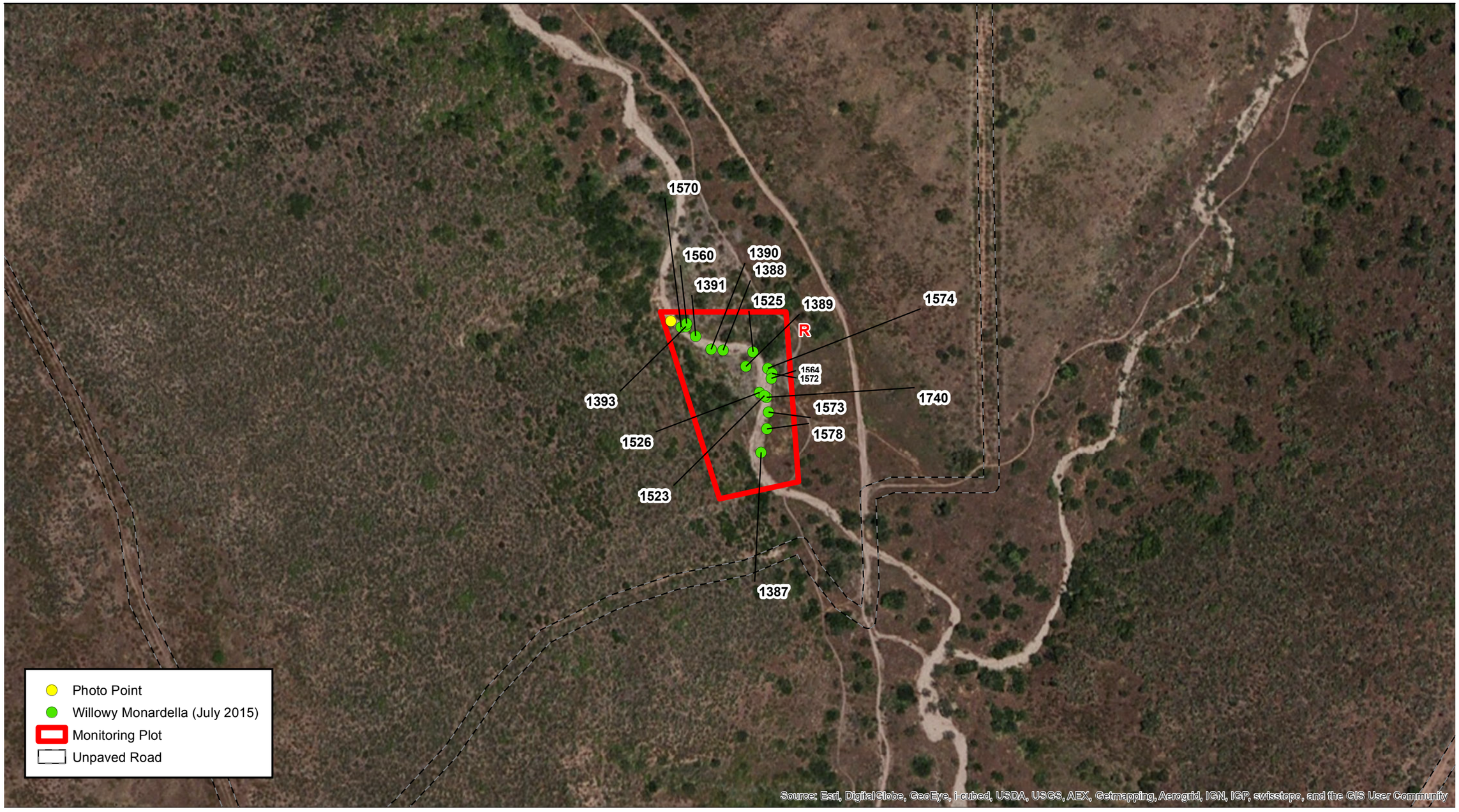
Source:

100 50 0 100 Feet

Scale: 1:1,200; 1 inch = 100 feet

Figure 3-10
Willowy Monardella Monitoring Results
Willowy Monardella Monitoring Plot Q

Path: \\ussdg1fp001.na.aecomnet.com\data\projects\2015\60334923_MrmrUplPlnts\900-CAD-GIS\920 GIS\922_Maps\WM_CensusPlant_Locs10_2_AllPlots.mxd, 12/16/2015, janssenn



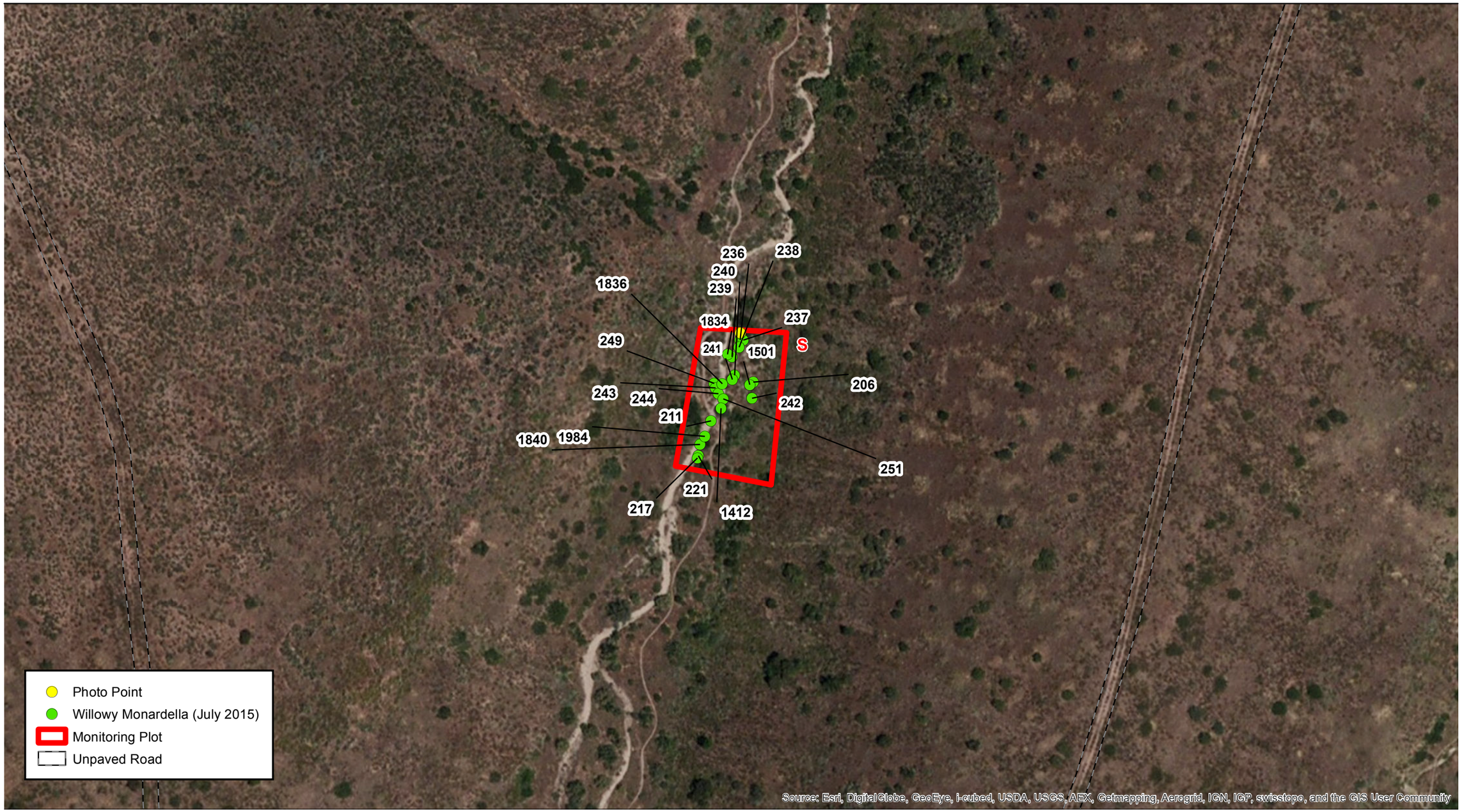
Source:

100 50 0 100 Feet

Scale: 1:1,200; 1 inch = 100 feet

Figure 3-11
Willowy Monardella Monitoring Results
Willowy Monardella Monitoring Plot R

Path: \\ussdg1fp001.na.aecomnet.com\data\projects\2015\60334923_MrmrUplPlnts\900-CAD-GIS\920 GIS\922_Maps\WM_CensusPlant_Locs10_2_Plots_N_O.mxd, 12/15/2015, janssenn



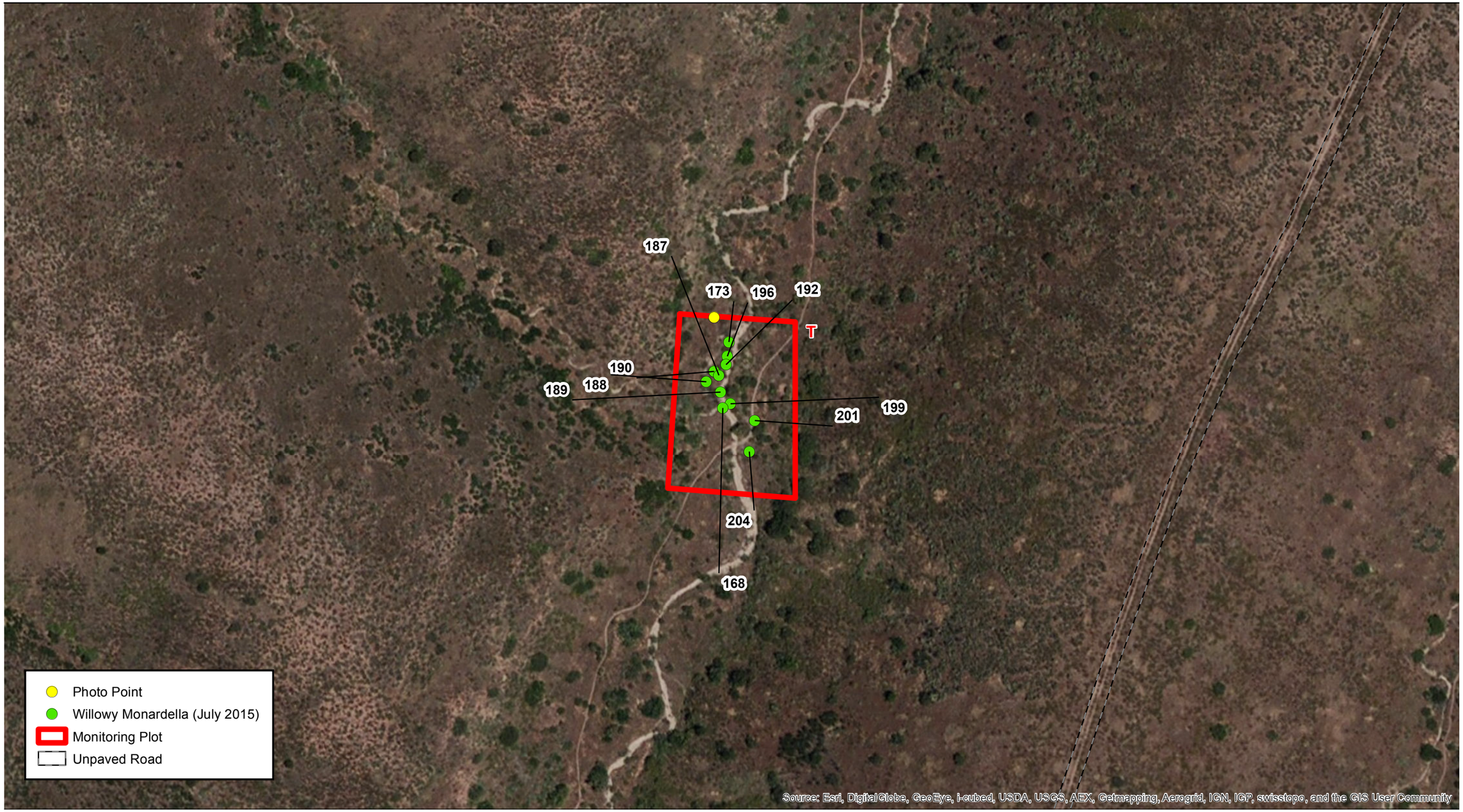
Source:

100 50 0 100 Feet

Scale: 1:1,200; 1 inch = 100 feet

Figure 3-12
Willowy Monardella Monitoring Results
Willowy Monardella Monitoring Plot S

Path: \\ussdg1fp001.na.aecomnet.com\data\projects\2015\60334923_MrmrUplPlnts\900-CAD-GIS\920 GIS\922_Maps\WM_CensusPlant_Locs10_2_Plots_N_O.mxd, 12/15/2015, janssenn



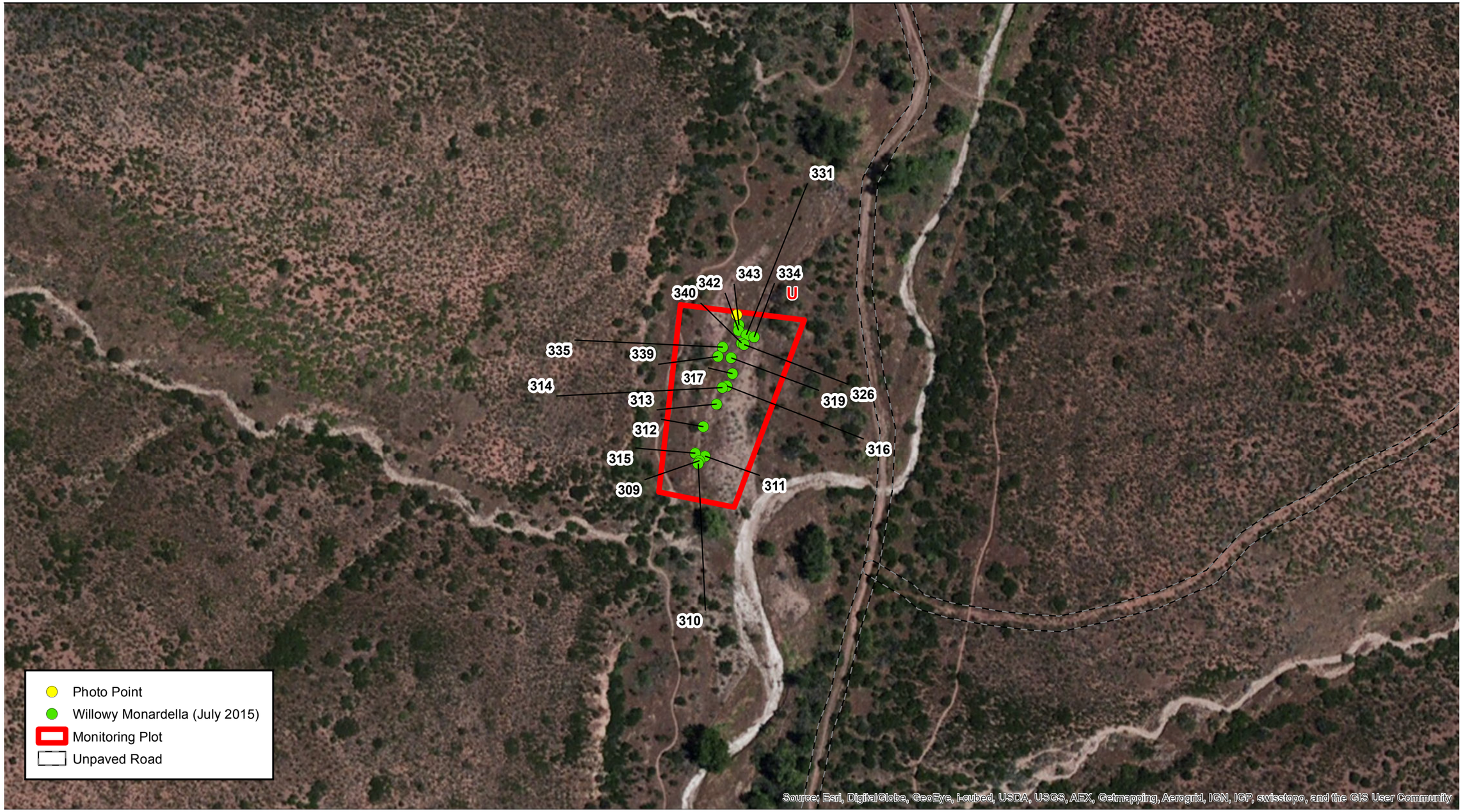
Source:

100 50 0 100 Feet

Scale: 1:1,200; 1 inch = 100 feet

Figure 3-13
Willowy Monardella Monitoring Results
Willowy Monardella Monitoring Plot T

Path: \\ussdg1fp001.na.aecomnet.com\data\projects\2015\60334923_MrmrUplPlnts\900-CAD-GIS\920 GIS\922_Maps\WM_CensusPlant_Locs10_2_Plots_N_O.mxd, 12/15/2015, janssenn



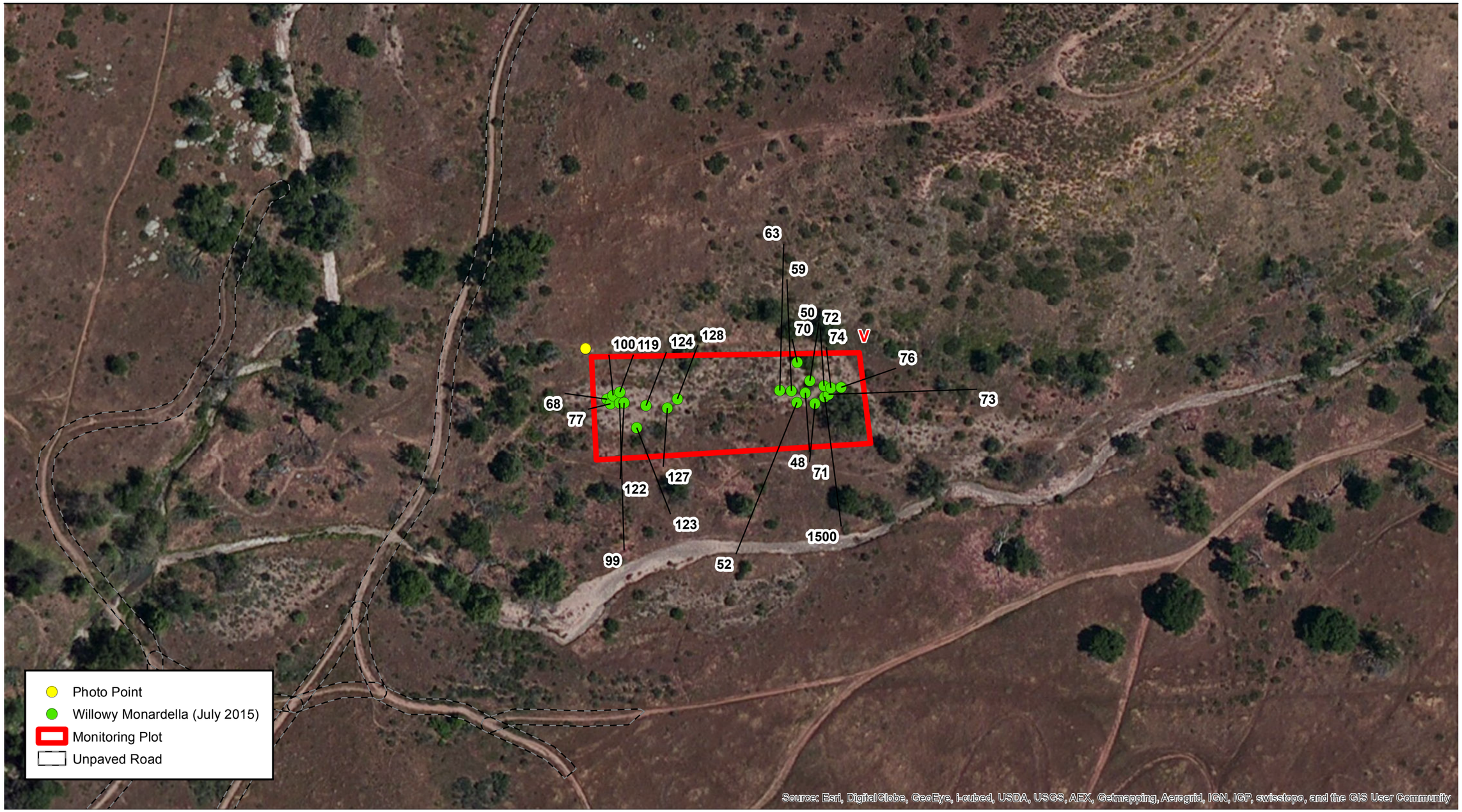
Source:

100 50 0 100 Feet

Scale: 1:1,200; 1 inch = 100 feet

Figure 3-14
Willowy Monardella Monitoring Results
Willowy Monardella Monitoring Plot U

Path: \\ussdg1fp001.na.aecomnet.com\data\projects\2015\60334923_MrmrUplPlnts\900-CAD-GIS\920 GIS\922_Maps\WM_CensusPlant_Locs10_2_Plots_N_O.mxd, 12/15/2015, janssenn



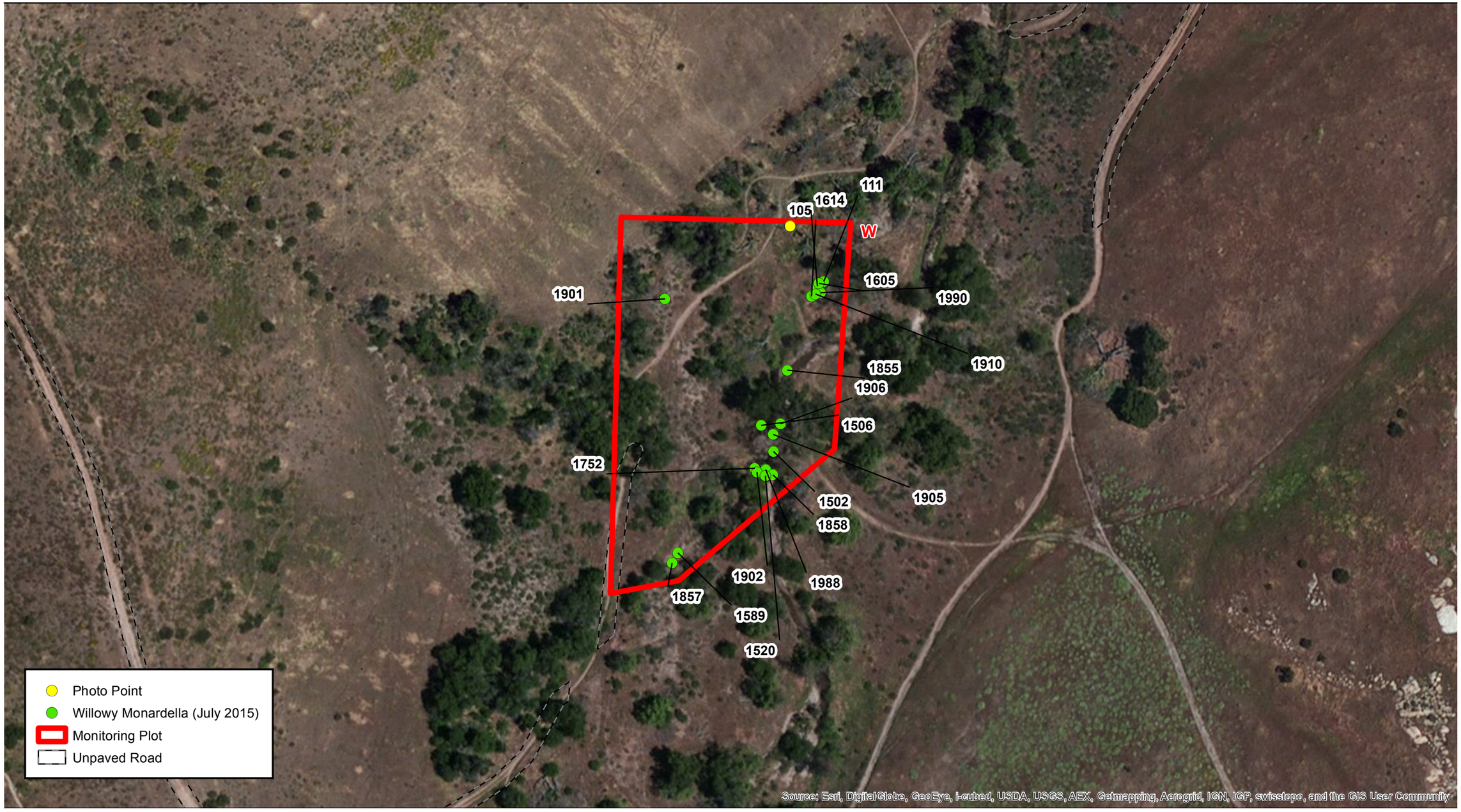
Source:

100 50 0 100 Feet

Scale: 1:1,200; 1 inch = 100 feet

Figure 3-15
Willowy Monardella Monitoring Results
Willowy Monardella Monitoring Plot V

Path: \\ussdg1fp001.na.aecomnet.com\data\projects\2015\60334923_MrmrUplPlnts\900-CAD-GIS\920 GIS\922_Maps\WM_CensusPlant_Locs10_2_Plots_N_O.mxd, 12/15/2015, janssenn



Source:

100 50 0 100 Feet

Scale: 1:1,200; 1 inch = 100 feet

Figure 3-16
Willowy Monardella Monitoring Results
Willowy Monardella Monitoring Plot W

Path: \\ussdg1fp001.na.aecomnet.com\data\projects\2015\60334923_MrmrUplPlnts\900-CAD-GIS\920 GIS\922_Maps\WM_CensusPlant_Locs10_2_Plots_N_O.mxd, 12/15/2015, janssenn

APPENDIX D

Project Photographs



Photograph 1: Willowy monardella clump with tag in Plot J within in drainage bottom. Photograph taken July 17, 2015.



Photograph 2: Willowy monardella clump 1568, within Plot L, growing on edge of eroding drainage feature. Photograph taken July 16, 2015.

Appendix D
Project Photographs 1 and 2



Photograph 3: Willowy monardella clump within Plot P on alluvial bench.
Photograph taken July 14, 2015.



Photograph 4: Willowy monardella clump growing near trail in Plot S.
Photograph taken July 17, 2015.

Appendix D
Project Photographs 3 and 4



Photograph 5: Caterpillar found on willowy monardella in Plot H. Likely to be a moth of the Geometridae (looper) but would need to be reared to verify its identity. Photograph taken July 16, 2015.



Photograph 6: Micro moth larva (Microlepidoptera) commonly found feeding on willowy monardella seeds. Photograph taken in Plot I, July 17, 2015.

Appendix D
Project Photographs 5 and 6



Photograph 7: Willowy monardella clump within Plot P on alluvial bench. Photograph taken July 14, 2015.



Photograph 8: Behr's metalmark (*Apodemia virgulti virgulti*) butterfly nectaring on willowy monardella clump within Plot Q. Photograph taken July 14, 2015 (identification by Bonnie Hendricks).

Appendix D
Project Photographs 7 and 8



Photograph 9: Bembicid wasp (probably *genus Steniola*) nectaring on willowy monardella clump within Plot L. Photograph taken July 16, 2015 (identification by David Faulkner).



Photograph 10: Willowy monardella seedling in Plot W. Photograph taken July 21, 2015.

Appendix D
Project Photographs 9 and 10

APPENDIX E

Monitoring Plot Photographs



Photograph taken July 15, 2015.



Photograph taken July 3, 2012 (Tetra Tech 2013).

Aspect – Southwest

Appendix E
Baseline Photographs of Monitoring Plot A



Photograph taken July 16, 2015.



Photograph taken July 10, 2012 (Tetra Tech 2013).

Aspect – East

Appendix E
Baseline Photographs of Monitoring Plot C



Photograph taken July 16, 2015.



Photograph taken July 5, 2012 (Tetra Tech 2013).

Aspect – East

Appendix E
Baseline Photographs of Monitoring Plot G



Photograph taken July 15, 2015.



Photograph taken July 5, 2012 (Tetra Tech 2013).

Aspect – West

Appendix E
Baseline Photographs of Monitoring Plot H



Photograph taken July 17, 2015.



Photograph taken July 5, 2012 (Tetra Tech 2013).

NOTE: Photograph is being compared to "Photograph 6" from the protocol manual. Plot I photograph from the protocol manual is not the same frame as the staked photograph point and recorded aspect ; however "Photograph 6" matches the frame.

Aspect – Northeast

Appendix E
Photograph Comparisons of Monitoring Plot I



Photograph taken July 17, 2015.



Photograph taken July 3, 2012 (Tetra Tech 2013).

Aspect – South

Appendix E
Baseline Photographs of Monitoring Plot J



Photograph taken July 16, 2015.



Photograph taken July 5, 2012 (Tetra Tech 2013).

Aspect – Southeast

Appendix E
Baseline Photographs of Monitoring Plot L



Photograph taken July, 15 2015.



Photograph taken July 6, 2012 (Tetra Tech 2013).

Aspect – East

Appendix E
Baseline Photographs of Monitoring Plot N



Photograph taken July 15, 2015.



Photograph taken July 3, 2012 (Tetra Tech 2013).

Aspect – Southeast

Appendix E
Baseline Photographs of Monitoring Plot O



Photograph taken July 14, 2015.



Photograph taken July 15, 2012 (Tetra Tech 2013).

Aspect – West

Appendix E
Baseline Photographs of Monitoring Plot P



Photograph taken July 14, 2015.



Photograph taken July 12, 2012 (Tetra Tech 2013).

Aspect – Southwest

Appendix E
Baseline Photographs of Monitoring Plot Q



Monitoring Plot R - Aspect – SE (120 degrees). Photograph taken July 17, 2015.



Monitoring Plot S - Aspect – S (200 degrees). Photograph taken July 17, 2015.

Appendix E
Baseline Photographs of Monitoring Plots R and S



Monitoring Plot T - Aspect – S (160 degrees). Photograph taken July 17, 2015.



Monitoring Plot U - Aspect – S (175 degrees). Photograph taken July 20, 2015.

Appendix E
Baseline Photographs of Monitoring Plots T and U



Monitoring Plot V - Aspect – S (170 degrees). Photograph taken July 20, 2015.



Monitoring Plot W - Aspect – S (170 degrees). Photograph taken July 21, 2015.

Appendix E
Baseline Photographs of Monitoring Plots V and W