Water Use Efficiency Program Expansion (WUEPE)

Proposition 50
Integrated Regional Water Management (IRWM)
Implementation Grant

South Orange County Watershed Management Area
State Water Resources Control Board – Proposition 50

Grant Agreement No. 07-542-550-3
Total Grant Funds $1,274,000

Final Project Report
December 2012

Submitted by:

Municipal Water District of Orange County
18700 Ward Street
Fountain Valley, CA 92708

Steve Hedges,
Water Use Efficiency Supervisor
Project Manager

Dr. Melissa Baum-Haley,
Water Use Efficiency Specialist
Project Evaluation

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For questions on this report:

Joseph Berg
Water Use Efficiency Programs Manager
714-593-5008
jberg@mwdoc.com

Grant Summary

Completed Grant Summaries are made available to the public on the State Water Resources Control Board's (SWRCB) website at http://www.waterboards.ca.gov/funding/grantinfo.html

Date filled out: **01/28/2008**

Grant Information: Please use complete phrases/sentences. Fields will expand as you type.
1. **Grant Agreement Number:** 07-542-550-0, amended to -2 & -3 (last #)
2. **Project Title:** Prop. 50 SOCIRWMP Water Use Efficiency Program Expansion
3. **Project Purpose – Problem Being Addressed:** Over 55% of water consumed in the urban environment is water applied to the landscape. Some of this applied water turns into runoff that contaminates local streams, rivers and the eventually the ocean. This project aimed to install 2,450 weather-based irrigation controllers (Smart Timers) at both residential and commercial properties. Smart Timers use localized weather and plant information to develop an individualized watering schedule to apply the correct amount of water for the sites watering needs. The proper application of landscape water reduces both the amount of water consumed and the amount of water that leaves a property as runoff. Included as one of the tasks in the project, the quantity and quality of surface runoff was evaluated to test the impact Smart Timers have on both reducing runoff and improving the quality of the runoff.
4. **Project Goals** a. **Short-term Goals:** Installation of 2,450 Smart Timers in commercial and residential settings in south Orange County. Additionally, up to 292 single-family residences will be targeted for installation of Smart Timers and irrigation system improvements. b. **Long-term Goals**: The reduction of potable landscape water waste by installing Smart Timers and retrofitting irrigations systems. Additionally, the reduction of and improvement of the water quality in, dry weather surface runoff by installing Smart Timers and retrofitting irrigations systems.
5. **Project Location**: 2,450 Smart Timers in South Orange County cities and unincorporated areas (Aliso Viejo, Dana Point, Laguna Beach, Laguna Hills, Laguna Niguel, Laguna Woods, Lake Forest, Mission Viejo, Rancho Santa Margarita, San Clemente, and San Juan Capistrano) and in the following watersheds: Aliso Creek, Laguna Creek, Salt Creek, Santa Ana River, San Clemente, San Diego Creek, and San Juan Creek. Additionally, 292 Smart Timers and irrigation system improvements in the Poche Beach watershed in San Clemente.
a. **Physical Size of Project**: Approximately 197,700 acres in south Orange County.
b. **Counties Included in the Project:** Orange County
c. **Legislative Districts:** Assembly Districts: 70, 71, 73; Senate Districts: 33, 35, 38
6. **Which SWRCB program is funding this grant?** Please "X" box that applies. ☐ Prop 13 ☐ Prop 40 ☒ Prop 50 ☐ EPA 319(h) ☐ Other
Grant Contact: Refers to Grant Project Director. **Name:** Marilyn Thoms **Job Title:** Watershed Manager
Organization: County of Orange RDMD **Webpage Address:** www.ocwatersheds.com
Address: Watershed & Coastal Resources Division, 300 North Flower Street, 7th Floor, Santa Ana, CA 92703

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Phone: (714) 834-2352	**Fax:** (714) 834-5016
E-mail: marilyn.thoms@rdmd.ocgov.com	
Grant Time Frame: Refers to the implementation period of the grant. **From:** July 1, 2007	**To:** December 31, 2013
Project Partner Information: County of Orange, Municipal Water District of Orange County, El Toro Water District, Irvine Ranch Water District, Laguna Beach County Water District, Moulton Niguel Water District, City of San Clemente, South Coast Water District, Trabuco Canyon Water District, and Metropolitan Water District of Southern California	
Nutrient and Sediment Load Reduction Projection: From similar studies previously conducted, a statistically significant reduction in Nitrogen Load (lbs/acre/day) will be achieved with this project through a reduction in dry weather runoff.	

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Executive Summary

In 2007, the Municipal Water District of Orange County (MWDOC) was awarded a grant from the State Water Resources Control Board for the South Orange County Integrated Regional Water Management Plan Water Use Efficiency Program Expansion Project (WUEPE). The WUEPE project projected the installation of 2,450 weather based irrigation controllers in new and existing residential (1,200) and commercial (1,250) landscapes. Additionally, the WUEPE project provided assistance for up to 292 poorly maintained residential irrigation systems, implementing a plan to improve their water application and water consumption. The WUEPE project was also tasked with performing a water use and water quality evaluation on a subset of those 292 residential properties.

In late 2006, when the development of Smart Timers was in its infancy, it was thought that when a property owner used an improperly programmed or neglected conventional irrigation controller, the amount of irrigation water applied to the landscape was in excess of the needs of the plant material or the ability for the water to percolate into the soil before it became water runoff. This excessively applied water is wasteful, and the runoff leaving the property can carry high concentrates of pollutants that enter local streams, rivers and eventually the ocean. By addressing the cause of excessive watering, property owners can both reduce water consumption and water runoff through the installation of a Smart Timer.

The goals of this project are to: 1) save valuable water supplies, thereby reducing our reliance on the State Water Project and improving water reliability; 2) reduce dry-weather runoff by better managing landscape irrigation; and 3) reduce non-point source pollution loads by reducing the dry-weather runoff that carries the pollutants to local receiving waters.

The WUEPE project combined the following programs for implementation within the South Orange County Integrated Regional Water Management Plan: (1) SmarTimer and Rotating Nozzle Rebate Programs, (2) Reserves Outdoor Sustainability Project, (3) The South County SmartScape Incentive Program, and (4) SmarTimer Give-A-Way Program. The WUEPE project was implemented using a rebate format designed to provide financial incentives to property owners for the retrofit of the high-water-consumption landscape devices to high-water-efficiency landscape devices. The Reserves Outdoor Sustainability Project and the South County SmartScape Incentive Program also included financial incentives for turfgrass removal.

The WUEPE project identified both commercial and residential property owners as prospective segments of the water using public for project targeting. Commercial properties included mostly Home Owner Associations, city and school facilities, and golf courses. WUEPE public outreach included: Bill inserts, Program flyers, Program page on the MWDOC website, Articles of interest in eCurrents, MWDOC's newsletter, Posts on social media pages, Promotion during Smart Irrigation Month (July), Enrollment in Landscape Performance Certification Program (commercial sites only), Letter sent from the Homeowners Associations to local residents, Door hangers, Postcards, Landscape renovation signs, and Educational materials.

The WUEPE Project was managed by MWDOC using a Rebate Administration Contractor to facilitate rebate incentives paid to WUEPE project participants. It also utilized Mission Resource Conservation

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District site water audit technicians to inspect smart timer and rotating nozzle installations, evaluate irrigation system deficiencies, and confirm irrigation system corrections and distribution system updates.

By the completion of the WUE project, 2,539 (104%) weather based irrigation controllers or Smart Timers were verified as installed, 272 (93%) residential properties received some level of irrigation system upgrades. The cost to implement this project totaled $4,968,736. These included costs to both purchase and install 1,324 commercial smart timers, 1,215 residential smart timers of varying timer capacities, and perform the 272 landscape system upgrades.

For a detailed evaluation of the impact of the WUEPE Project, a sub-program sample set was taken from the Reserves Outdoor Sustainability Project (ROSP). Historical water consumption data was collected for both the retrofit and control group within the Reserve Outdoor Sustainability Project area. Historical data consisted of 5 years of pre-retrofit and 1 year of post retrofit data. In addition to water consumption data, water quality data was collected for testing purposes. WUEPE Project participant data was also data based for over 2,500 project participants.

Through the water consumption/water quality evaluation performed, 33.6 gallons per day (gpd) on average (10.7 gpd to 56.5 gpd at the 95% confidence level) could be saved from the installation of a Smart Timer. To evaluate the project a statistical impact evaluation of the reductions in water consumption from the smart controller installations, irrigation system efficiency improvements, and turf replacement was conducted. The effects of the three types of smart controller installations were evaluated and compared to nonparticipating households based on one year of post-intervention consumption data within the sample.

The WUEPE Project came to an end due to the term of the agreement expiring. The water use efficiency staff at MWDOC is dedicated to implementing water use efficiency programs that both educate the public and implement projects to reduce the use of water in Orange County California.

The water use efficiency staff at the Municipal Water District of Orange County (MWDOC) is dedicated to implementing water use efficiency programs that both educate the public and implement projects to reduce the use of water in Orange County California. To this end, MWDOC will continue to seek out additional grant opportunities to continue its offering of rebates for the replacement of inefficient high-water using devices with high-efficiency-low-water using devices such as Smart Timers, high-efficiency-low-precipitation sprinkler nozzles, the use of southern California friendly plant choices, and landscape irrigation system maintenance programs.

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Problem Statement & Relevant Issues

In most instances, when a property owner uses a conventional irrigation controller, the amount of irrigation water applied to the landscape is in excess of the needs of the plant material or the ability of the water to percolate into the soil before it becomes nuisance water leaving the property in the form of runoff. In today's environment when water is in increasingly short supply, the excessive water is wasteful and the runoff leaving the property can carry with it high concentrates of pollutants that enter local streams, rivers and eventually the ocean. By addressing the cause of excessive watering - the improperly programmed conventional irrigation controller - property owners can both reduce water consumption and water runoff by installing a weather-based irrigation controller, or Smart Timer. Smart Timers use site specific information such as the site's plant and soil type, geographic location (for ET), and the time of year to adjust the controller's internal program. When installed properly, the Smart Timer will apply the correct amount of water specific to the site's landscape needs.

In addition to the landscape controller, a poorly maintained irrigation system will also lead to both the wasteful use of water and water runoff. By addressing a site's poorly designed irrigation system (low distribution uniformity), the use of high precipitation rate sprinkler nozzles, and the ill conceived plant palette, water usage will also be reduced.

This project addressed both the conventional irrigation controller by providing a rebate incentive for the purchase, installation, and programming of over 2,450 Smart Timers. It also provided for up to 292 irrigation system improvements, and lastly it evaluated in a controlled area both the water reduction and water quality improvements when Smart Timers and irrigation system improvements were implemented.

Project Goals

The goals of this project are to: 1) save valuable water supplies, thereby reducing our reliance on the State Water Project and improving water reliability; 2) reduce dry-weather runoff by better managing landscape irrigation; and 3) reduce non-point source pollution loads by reducing the dry-weather runoff that carries the pollutants to local receiving waters.

The objective of this project is to offer incentives to encourage the installation of up to 2,450 SmarTimer controllers and up to 292 irrigation system improvements in new and existing single-family homes and commercial landscapes throughout the Integrated Regional Water Management (IRWM) area. The proposed project will be implemented throughout all cities and water districts in the IRWM.

Project Location

The WUEPE project was located throughout the entirety of MWDOC's service area located within the South Orange County Integrated Regional Water Management Area, see Figure 1.

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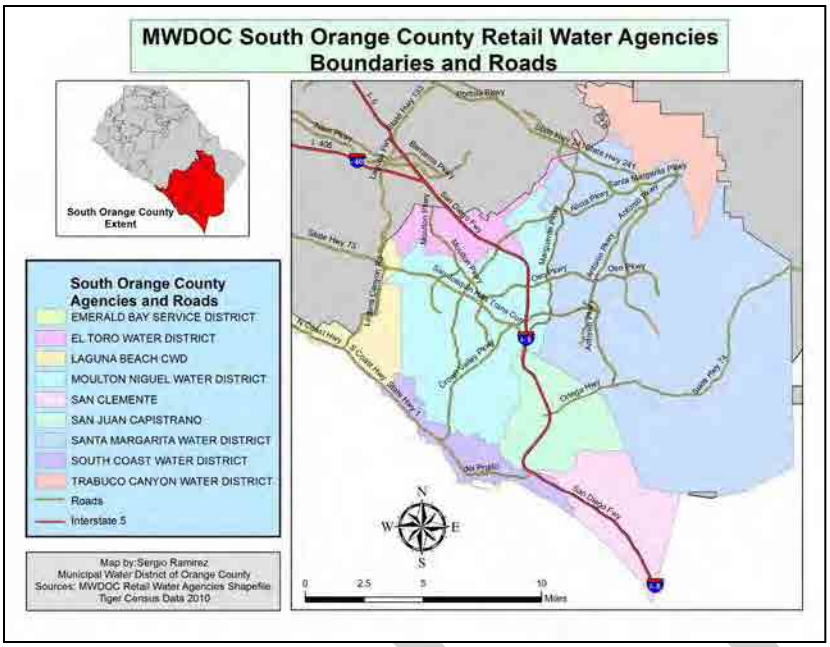

Figure 1. MWDOC's service area within the South Orange County Integrated Regional Water Management Area

Project Description

The WUEPE project combined the following programs for implementation within the South Orange County Integrated Regional Water Management Plan:

1. Standard Rebate Programs
    - SmarTimer Rebates
    - Rotating Nozzle Rebates
2. Reserves Outdoor Sustainability Project
3. The South County SmartScape Incentive Program
4. SmarTimer Give-A-Way Program

Through the WUEPE project, it was anticipated that up to 2,450 "SmarTimer" irrigation controllers in new and existing residential (1,200) and commercial landscapes (1,250) will be installed, and the correction and improvement of landscape irrigation distribution systems will be performed for up to 292 participants using a Rebate Program format. This effort is anticipated to save more than 1,050 acre feet of water per year and reduce runoff and non-point source pollution associated with these properties by more than 50%. Prospective participants will be offered rebate incentives to avoid installation of antiquated timers in new construction or to replace existing antiquated irrigation timers for existing landscapes. Unlike antiquated timers that require action by the site manager to reprogram the irrigation schedule regularly, new Smart Timers are considered state-of-the-art because they automatically adjust irrigation schedules as weather conditions change without action by the site manager. Smart Timers alone have been proven to save water and to reduce runoff and pollution per the findings in The Residential Runoff Reduction Study (July 2004, available at http://www.mwdoc.com/services/wue-research). The WUEPE project incorporates a pilot element

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aimed at additional water savings and runoff reductions where wasteful irrigation distribution system deficiencies can be corrected. WUEPE's Reserves Outdoor Sustainability Project and the SmartScape Program also targeted irrigation distribution system improvements, such as changing from high precipitation overhead spray sprinklers to highly-efficient drip emitters, as well as support the conversion of water-thirsty grass lawn areas to drought-resistant plants. Changing plant species can reduce water demand at a site by 50-85%, as estimated in the Guide to Estimating Irrigation Water Needs of Landscape Plantings in California (University of California Cooperative Extension, available at www.owue.water.ca.gov/docs/wucols00.pdf).

Additionally, all commercial landscapers that participated in the WUEPE Project were automatically enrolled in MWDOC's Landscape Performance Certification Program. This program provides monthly irrigation performance reports, customized to each site, to the property owner, property manager, and landscape maintenance contractor. The Irrigation Performance Report is accessed on the program website, and quantifies the amount of water applied to the landscape by using metered water use data from retail water agencies and comparing it to the amount of water that should be applied based upon the budget. The budget is calculated based upon the irrigated area, plant palette, climate zone, and irrigation system efficiency. This program monitors water use of program participants, but is operated and funded independently of the WUEPE Project.

Project Type

The WUEPE Project was managed by MWDOC using a Rebate Administration Contractor to facilitate rebate incentives paid to WUEPE project participants for the installation of Smart Timers. It also utilized Mission Resource Conservation District site water audit technicians to inspect smart timer and rotating nozzle installations, evaluate irrigation system deficiencies, and confirm irrigation system corrections and distribution system updates. See Appendix C – Sub-Contractor Information.

Project Costs

Total Costs

Cost to implement this project totaled $4,968,736. This included costs to both purchase and install 1,324 commercial smart timers, 1,215 residential smart timers of varying timer capacities, and perform 272 landscape system upgrades. System upgrades consisted of irrigation system improvements, changing out high water using plants for California Friendly plants, and the installation high efficiency landscape devices such as high efficiency sprinkler nozzles and Smart Timers.

Funding source

Agency:	State Water Resources Control Board
Program:	Non-point Source Pollution Control Program
Source:	Proposition 50
Amount:	$1,274,000

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Matching funds

Agency:	Municipal Water District of Orange County
Program:	Water Use Efficiency
Source:	Local
Amount:	$3,695,657

Project Methodology

The WUEPE project was implemented using a rebate format designed to provide financial incentives to property owners for the retrofit of high-water-consumption landscape devices to high-water-efficiency landscape devices (Smart Timers). The project began by both identifying market segments to invite to participate and the landscape devices that would be offered to these market segments. Both commercial and residential property owners were segments of the water using public that the project decided to include. Commercial properties included mostly Home Owner Associations (HOA's), city and school facilities, and golf courses.

The Smart Timer was the target device to be retrofitted in the project. At the beginning, only makes and models from start-ups were available. Examples of these were Smart Timers from Accurate WeatherSet, WeatherMatic, Aqua Conserve, and Hydropoint WeatherTrack. As the project matured, the larger irrigation companies such as Hunter, Rain Bird, Irritrol, and Toro developed Smart Timers that were approved for the project. This was one of the unintended goals of the project, to cause a market transformation.

Next came establishing the rebate levels for the landscape device offerings. Since property owners were going to be asked to replace a conventional landscape device with a Smart Timer, the rebate had to be set at sufficient enough levels to bridge the difference between a conventional landscape device and the Smart Timer. For instance, it was determined that the retail price for a conventional residential irrigation timer ranged from $59 to $199, with the Smart Timer ranging from $399 to $899. Because of the large difference between the two, the rebate initially averaged $540. This average decreased to $325 by the end of the project, primarily due to the decreased cost of the Smart Timer.

With these initial project steps established, the market segments selected; Smart Timer makes(s) and model(s) approved; rebate levels identified, the next step for the project was to acquire a rebate administrator. The project used a regional rebate administrator, their main function was to develop and issue, receive and review, and then approve the project's rebate applications. Finally, they would issue the participants rebate check. Included with handling the application, the rebate administrator would also database all information connected to applicant's participation in the program.

Once the project began, using the outreach materials shown in Appendix F, MWDOC would promote the project and its benefits to both residential and commercial property owners. This effort included bill inserts, door hangers, newsprint ads, the creation of a project website, and bill messages from the participating retail water agencies.

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As one of the tasks within the project, MWDOC inspected 100% of both commercial and residential Smart Timer installations. This involved hiring a third party contractor to schedule, do the site inspection, and report the results back to MWDOC. Appendix C - Sub Contractor Information details their role in the project.

Another task within the project was the conducting up to 292 irrigation system improvements at residential sites. A total of 272 irrigation system upgrades were performed, that included 68 within the ROSP area. The ROSP area as detailed in the following section served as the basis for the evaluation, another required task. Residential sites that participated were targeted for their high water use. This data was obtained from the local water agency. Potential sites were first evaluated to determine if their irrigation system was in need of upgrades. Once a site qualified, their irrigation system was retrofitted with high efficiency rotating nozzles; a Smart Timer was installed; leaks were fixed; heads were moved or removed to improve distribution uniformity; and if the property owner agreed, non-functional turf was removed and California Friendly plants were installed.

Finally one last sub-project was implemented; it was the Smart Timer Give a Way Project (STGAP). The purpose of this project was to test the steps required to run a direct install program for the installation of Smart Timers. Up to this point it was the property owner's responsibility to either install the device themselves or hire an installation contractor to perform the installation work. The steps to implement the STGAP were to qualify a short list of qualified Smart Timer installers. This was accomplished through a Request for Qualifications (RFQ). Once the list of qualified installers was vetted, MWDOC conducted a training seminar to instruct the contractors of the goals of the project, train them in their roles and responsibilities, and to emphasize the level of customer service required. An additional step was to secure an irrigation distribution house to work with the contractors in their Smart Timer acquisitions. Ultimately 450 Smart Timers were installed in just under 3 months at no cost to the property owner.

And lastly, MWDOC submitted the required deliverables every quarter throughout the term of the agreement.

Project Assessment and Evaluation Plan

As part of the WUEPE Program a Project Assessment and Evaluation Plan, Monitoring Plan, and Quality Assurance Project Plan were developed and submitted to the State Water Resources Control Board. These plans were utilized to outline the protocols for how to assess differences in the flow, conductivity, bacteria, and nutrient concentrations between the retrofit group and the control groups to evaluate any reduction in the concentrations of conductivity, bacteria, and nutrients based on the reduction of the flows; and assess differences in water consumption between the retrofit and control groups to evaluate any seasonal variances in water consumption with data collected one year after the retrofit process is completed.

To collect the pre-construction baseline data, reconnaissance and measurements were conducted during dry weather for the designated period within the first year of the Project Term. A technical subcontractor (Sierra Labs) was retained to install, operate, and maintain continuous low-flow and conductivity monitoring equipment at all assessment locations. Once-weekly samples of low-flow water were collected and analyzed for fecal indicator bacteria, nitrogen and phosphorus nutrients, and Dissolved Organic Carbon. The water usage data for the pre-construction baseline monitoring period

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was obtained from local water agencies for all water meters within the sub-watershed area draining to the assessment location.

For the post-construction data collected, measurements were collected during the designated dry weather period after the end of the BMP Implementation Period at all assessment locations. Continuous low-flow and conductivity monitoring equipment was installed, operated, and maintained. Twice-weekly samples of low-flow water at each assessment location were to be collected and analyzed by the laboratory for fecal indicator bacteria, nitrogen and phosphorus nutrients, and Dissolved Organic Carbon. Water usage data for the post-construction monitoring period from local water agencies for all water meters within the sub-watershed area draining to the assessment location was obtained.

Existing Data

For a detailed evaluation of the impact of the WUEPE Project, a sub-program sample set was taken from the Reserves Outdoor Sustainability Project (ROSP). Historical water consumption data was collected for both the retrofit and control group within the Reserve Outdoor Sustainability Project area. Historical data consisted of 5 years of pre-retrofit and 1 year of post retrofit data. In addition to water consumption data, water quality data was collected for testing purposes. WUEPE Project participant data was also databased for over 2,500 project participants.

Descriptive Analysis of ROSP Irrigated Landscape Area

This Section provides a descriptive analysis of parcels in the Reserve Outdoor Sustainability Project located within the City of San Clemente in southern Orange County. The objective is to quantify any improvement in irrigation efficiency of retrofit customers with a control group of similar customers in the same housing development.

Parcel Size and Irrigated Landscape Area

The size of landscape parcels were statistically compared between the Control and Retrofit areas of the ROSP using county tax assessor data. Parcels in the Control area were about 20 percent smaller than parcels in the retrofit area. This difference was statistically significant at a 99.9% confidence level.

Just as not all parcels are of equal size, the area irrigated by homeowners are different sizes. Since this is a study of irrigation efficiency, the irrigated area by customer becomes important. The larger the irrigated area, the greater the potential volumetric use of irrigation water. To get a better understanding of irrigated area, a stratified sample was developed and irrigated area estimates were developed for parcels in the Control area and for non-participating households in the Retrofit area.

Parcels within The Reserve were stratified by size, from 5,000 to more than 12,000 square feet. For each of the strata, the average size of irrigated area was determined. For the Retrofit Zone, the measured irrigated areas of retrofitted customers were used as sample sizes within strata. For ROSP participants, in San Clemente, the area measurements were performed by irrigation contractors. For the Control Zone, sample irrigated areas were determined using Google Earth Pro (see Figure 2).

Using the sample irrigated area sizes, extrapolations were made to estimate average irrigated area within each parcel size strata. The results are shown in Appendix D, Table D-1. Of the 239 retrofit parcels included in this analysis, 50% had parcel areas from 6000 to 7999 ft^2, corresponding to an average

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irrigated area range from 1,571 to 2,073 ft^2. Overall, the irrigated areas ranged from 518 to 5,354 ft^2, with a total of 516,126 ft^2 of retrofit irrigated area.

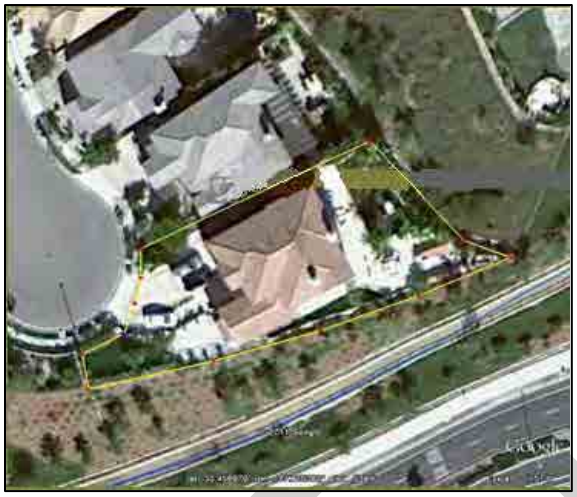

Figure 2. Screenshot of a sample irrigated area calculation from Google Earth Pro

Storm Drain Flow Monitoring

As reported in the GHD December 2009 report, "The Reserve Outdoor Sustainability Project Final Report", storm drain flow was monitored at two sites in The Reserve community within the City of San Clemente, California. The purpose of the flow monitoring was an attempt to detect if storm drain flows might detect differences in irrigation practices in two hydraulically defined zones that separately drained to the two flow monitoring stations. Changes in irrigation practices might reduce irrigation runoff and therefore reduce flows in one of the storm drains. See Figure 3, map for the Control Zone and Retrofit Zone.

The volume of measured runoff may depend on a variety of influences, such as: size of watershed, natural precipitation, saturated groundwater discharge, water distribution system leaks, irrigation system leaks, construction water spills, and mismanaged applied irrigation. Precipitation is generally light or negligible during Orange County summers. The GHD study report does not comment on water system leaks or spills, so the assumption, correct or not, is that the primary source of runoff should be mismanaged applied irrigation.

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Figure 3. The Reserve Retrofit and Control Areas

For landscapes with similar proportions of plant types (the landscape water use coefficient K_L being equal), a larger irrigated area should require more irrigation water by volume. Therefore, it is useful to compare the volume of irrigation water per unit area.

Table D-2 summarizes parameters of the study area. Important to note are that: the Retrofit Zone is substantially larger than the Control Zone in terms of the number of customers and the area of residential parcels. However, the proportion of irrigated area to parcel size is almost equal in both zones.

The GHD report recognized that the Retrofit Zone had many more customers than the Control Zone, but did not acknowledge that the Control Zone was less than 40 percent of the total parcel sizes of the study zones. In addition to irrigation by residential customers, the HOA irrigated substantial vegetated areas within both the Control Zone and Retrofit Zone.

Similar to the studied customers, the HOA water may:

- Be completely used by vegetation (evaporation and transpiration)
- Overflow into catchment facilities
- Percolate into the groundwater basin
- Reemerge from groundwater and flow into storm drain facilities
- Leak from irrigation pipes

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New Data

Comparison of Irrigated Area

If irrigation efficiencies and customer water use characteristics of the control and retrofitted areas were equal before the study began, then the water consumption per household and per unit area should be similar prior to the start of the ROSP. This is an empirical question that is next examined.

Evapotranspiration (ETo) is typically expressed in inches that can be readily converted into a volumetric measure for a given area of landscape. Table D-3 provides ETo translated into CCF required for 1,000 ft^2 of irrigated area. For instance, satisfying 12 inches of ETo would require 10 CCF per 1,000 ft^2 of irrigated area. The annual ETo from 2008 to 2010 declined from 48.3 to 45.1 inches, resulting in a range of 40.3 to 37.6 CCF per 1,000 ft^2 of irrigated area.

Home Owners Association Irrigation

HOA consumption is measured through a dedicated landscape water meter therefore, the data reflects only irrigation water not other uses. Table D-4 compares HOA irrigation applications for the Control Zone and Retrofit Zone. When expressed in water use per 1,000 square feet, the applications to the Control Zone and Retrofit Zone are almost equal, approximately 10 CCF per 1,000 square feet. This holds true in both 2008 and 2009. For the study periods, Table D-5 also shows the water use in CCF per 1,000 square feet.

Comparison of HOA and ETo for both years are consistent with appropriate irrigation application for the mix of landscape vegetation maintained by the HOA. Little if any runoff from HOA applied water should result. We can ignore the HOA component for the rest of the analysis.

Residential Irrigation

Table D-5 shows total customer water use during 2008 and 2009. It is important to note that the measured total water use per customer shed little light on differences in customer water use practices, both indoor and other non-irrigation applications, i.e. number of residents per household, frequency of residents occupying the house, water using appliances, spas, and swimming pools. Indoor water end uses and outdoor water end uses are not separately reported because this study did not measure separate end uses of water.

For the periods examined the water use per unit area per day during 2008 is slightly greater in the Control Zone than the Retrofit Zone. During the 2009 periods, water use by the retrofitted customers is slightly less (0.28 CCF/1,000 ft^2) than water use in the Retrofit Zone and the Control Zone, 0.32 and 0.34 CCF/1,000 ft^2 respectively. These comparisons provide a coarse analysis showing preliminary indicators.

Relationship of Irrigated Landscape Area to Parcel Size

Figure 4 depicts a graph of the relationship between irrigated landscape area and parcel size (minus the building footprint) shows a positive relationship. The straight line shows the prediction of a simple linear relationship for the 110 sampled parcels that can be written as a formula.

$$IrrigatedLandscapeArea = -324\ ft.sq. + 54.6\% * (ParcelSize - BuildingFootprint)$$

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These coefficients are derived by a simple Ordinary Least Squares [OLS] regression. Note that this relationship may not be linear as the data cloud exhibit some nonlinearity for large parcels (that is, the relationship is not proportional, landscape areas greater than 5400 square feet are rare within this sample.)

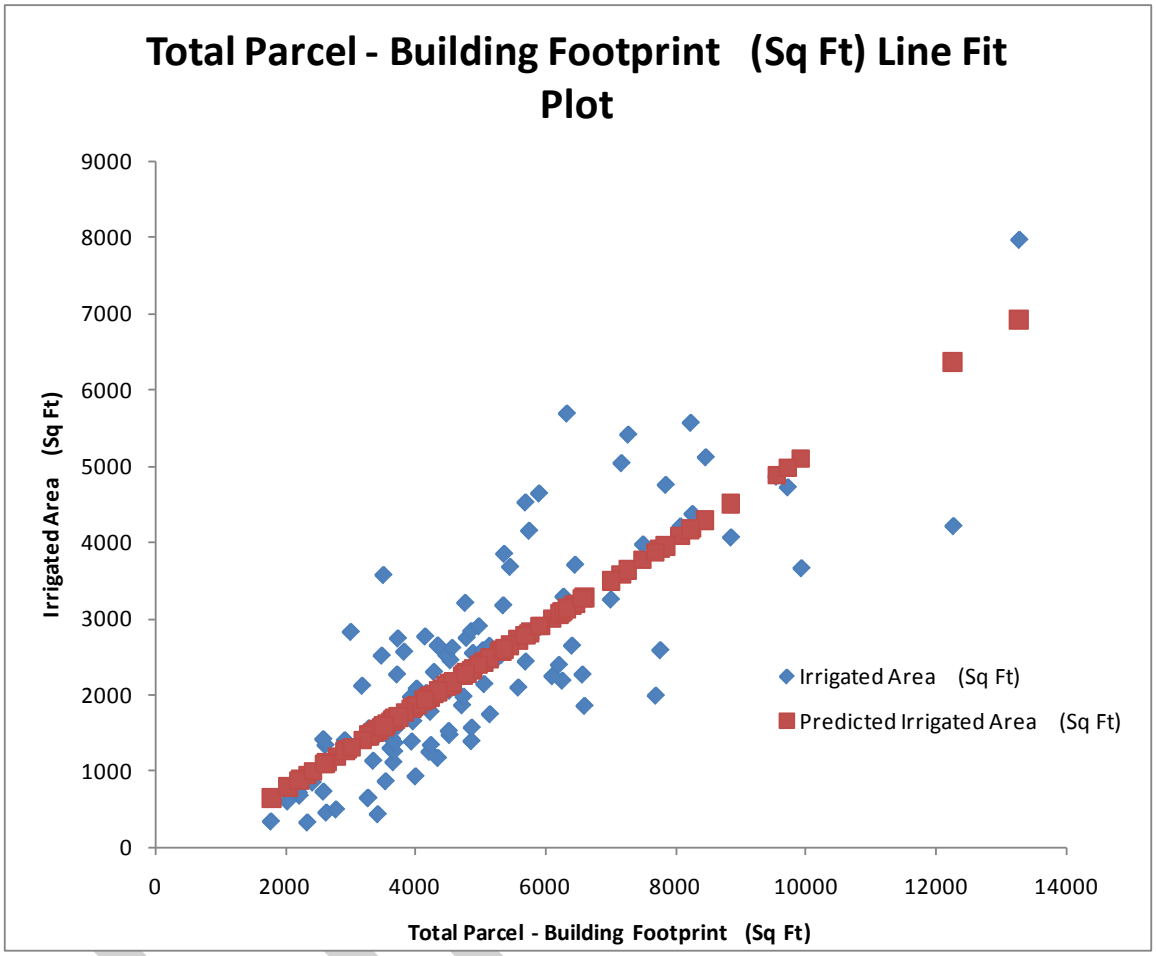

Figure 4. Total Parcel - Building Footprint

Data Evaluation

To isolate water savings attributable to this program, the analysis compared participant water use to that of a similar control group of nonparticipants. The empirically measured water savings of this analysis can be summarized.

Effect of ROSP on Average Water Use

Water savings per site were estimated from the statistical impact evaluation to be, on average, 33.6 gallons per day on average (10.7 gpd to 56.5 gpd is the 95 percent confidence level). ROSP participants removing turf may have saved more water, but the difference in savings was not statistically distinguishable at classical significance levels within the year and a half of available post-installation consumption. These savings are in addition to the ongoing level of water savings exhibited in the control group attributable to drought response measures, regional messaging, ordinances, etc.

Effect of ROSP on Water Use through the Year

In Figure 5, several observations should be made. First, the difference between the two horizontal lines corresponds to the estimated mean reduction of approximately 33.6 gallons per day. Second, the assumption of a constant 33.6 gallon per day effect does not hold true throughout the year. Smart Timers and irrigation system improvements apply water in the spring where ETo is high—the shape of seasonal demand is very similar in the spring growing season and while the greatest reduction occurs in the fall. In the retrofit group, although there was a net positive water savings overall, the water uses was actually slightly higher in the summer months following the retrofit, but significantly lower in the winter months. A peak reduction is also evident. Table D-6 expresses the net savings by month in tabular form.

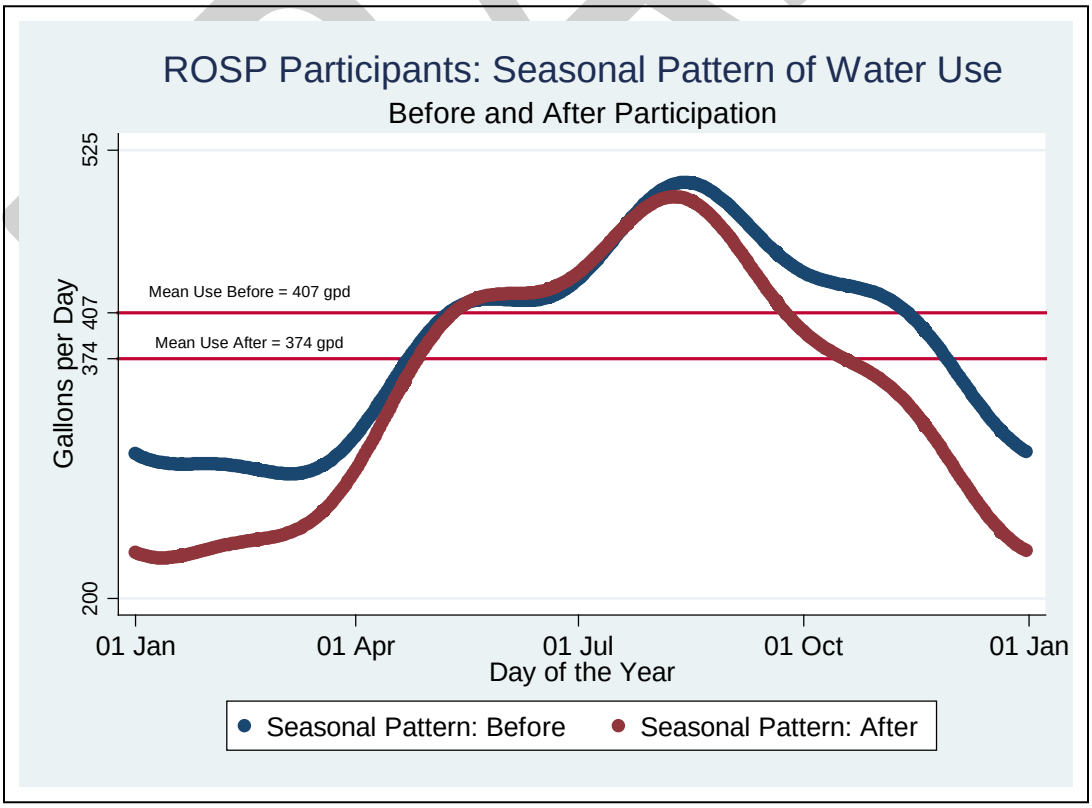

Figure 5. ROSP Participants: Seasonal Pattern of Water Use

Cost Effectiveness Analysis

As a pilot project to test new methods for combining potable water savings and irrigation runoff reduction, the ROSP generated new information about single family customer responsiveness to irrigation efficiency incentives up to three thousand dollars. This level of incentive resulted in 30 percent (n = 73) of homes participating in the program compared to previous studies that offered significantly lower incentives that achieved levels closer to 10% participation.

The program cost-benefit analysis yielded an approximately $580 per acre-foot based on the project lifetime water savings. From the current estimated level of water savings, one could not necessarily justify large scale implementation of an identical program based on avoided water supply costs alone. Lessons learned from this program have been incorporated into the implementation of other water use efficiency programs in Orange County and in the design of future programs.

More information on the statistical modeling specification and estimation are provided in the Reserve Outdoor Sustainability Project Report.

Public Outreach

WUEPE public outreach was categorized into four unique programs each with individualized marketing. Examples of the outreach material can be found in Appendix F – Outreach Material.

1. Standard Rebate Programs: SmarTimer Rebates & Rotating Nozzle Rebates
    - Bill inserts
    - Program flyers
    - Program page on the MWDOC website
    - Articles of interest in eCurrents, MWDOC's newsletter
    - Posts on social media pages
    - Promotion during Smart Irrigation Month (July)
    - Enrollment in Landscape Performance Certification Program (commercial sites only)
2. Reserves Outdoor Sustainability Project
    - Letter sent from the Homeowners Associations to local residents
    - Door hanger
    - Postcard
    - Landscape renovation signs
3. The South County SmartScape Incentive Program
    - Landscape renovation signs
    - Program page on the MWDOC website
4. SmarTimer Give-A-Way Program
    - Program page on the MWDOC website
    - Educational Materials

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Conclusions

Project Evaluation and Effectiveness

Performance Standards

The objective of this project was to provide incentive to encourage the installation of up to 2,450 SmarTimer controllers and up to 292 irrigation system improvements in new and existing single-family homes and commercial landscapes. In total 2,539 Smart Timers, 104% were installed through this program and 272 irrigation system improvements, 93% were facilitated. Through a statistical evaluation, program participants were found to save approximately 33.6 gallons per day (gpd) on average (10.7 gpd to 56.5 gpd at the 95 percent confidence level). Although there was a net positive water savings overall, the water uses was actually slightly higher in the summer months following the retrofit, but significantly lower in the winter months.

Monitoring

To evaluate the project a statistical impact evaluation of the reductions in water consumption from the smart controller installations, irrigation system efficiency improvements, and turf replacement was conducted. The effects of the three types of smart controller installations were evaluated and compared to nonparticipating households based on one year of post-intervention consumption data within the sample.

Pre- and post-retrofit assessments for water usage, dry-weather runoff flow, and water quality measures (fecal indicator bacteria and nutrient load among others) were also assessed for both control and retrofit sites. As part of the evaluation, an observation-specific data quality measure for use in subsequent modeling was prepared using robust regression methods. In an effort to detect changes in nutrient loading, laboratory grab sampling and continuous flow monitoring was conducted during dry-weather months for the pre-retrofit (2008) timeframe and the post-retrofit (2009) time frame.

Lessons Learned

The WUEPE project contributed to Smart Timer market transformation. Smart Timers are a new technology which will require a learning curve by consumers to understand how they work and how to use them. The manufacturer contribution to market transformation with direct influence from this project included: Follow-up technical assistance; Development of technical resources to assist consumers; and YouTube videos and irrigation scheduling tools.

Providing direct installation of Smart Timers can greatly increase program participation. The standard rebate program formats yielded approximately 40 rebates per month as compared to the direct install program format which resulted in 550 installations in 6 weeks by just 8 contractors. The direct install format shifts the motivation into the hands of the installer encouraging market transformation at the ground level.

With regards to single family residential irrigation systems, existing system inefficiency is a major issue. Most of these systems were Ppoorly maintained therefore resulted in water

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waste/excessive use and irrigation (dry-weather) runoff. The cost to bring the typical system into good operating condition was more than $1,500. The public is interested in a turn-key Landscape Improvement Program, but not willing to pay for it. Without increasing the existing system's efficiency the program effectiveness can be compromised.

There were reliability and validity problems with the flow monitoring data. As noted in both additional flow monitoring reports. As a result of the problems with the flow monitoring data, no conclusions can be drawn of any impact from the irrigation retrofits installed in the retrofit area. It would be recommended to increase frequency of monitoring the equipment maintenance and data collection. With runoff samples collected two times per week instead of once and water quality samples collected three times per week instead of twice.

Finally, Water agencies and stormwater permit holders have shared goals and benefit from joint program promotion. These shared goals include water savings and irrigation runoff.

Project Terminated

The WUEPE Project ended due to the term of the agreement expiring. The project goals were to install 2,450 Smart Timers and 2,539 were installed. The agreement provided $1,274,000 to assist with the Smart Timer installation incentives. By the end of the project, $1,273,078 was used to help with project expenses. There was a required $2,620,490 in matching funds; the project had $3,695,657 in matching funds.

Next steps

The water use efficiency staff at the Municipal Water District of Orange County (MWDOC) is dedicated to implementing water use efficiency programs that both educate the public and implement projects to reduce the use of water in Orange County California. To this end, and even though this project has ended, MWDOC will continue to seek out additional grant opportunities to continue its offering of rebates for the replacement of inefficient high-water using devices with high-efficiency-low-water using devices such as Smart Timers, high-efficiency-low-precipitation sprinkler nozzles, the use of southern California friendly plant choices, and landscape irrigation system maintenance programs. Until such time as code standards have been implemented, standards that will make it impossible to purchase inefficient landscape devices, MWDOC will continue to offer rebate incentives to assist with the public's choices to speed up the reduced consumption of water in the outdoor setting.

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Appendices

Appendix A - List of References

Chesnutt, T.W. (2004). "Residential Runoff Reduction Study; Statistical Analysis of Water Savings and Runoff Reduction." Prepared by A&N Technical Services, Inc. for Municipal Water District of Orange County and Irvine Ranch Water District.

Chesnutt, T.W. (2006). "Commercial ET-Based Irrigation Controller Water Savings Study." Prepared by A&N Technical Services, Inc. for Municipal Water District of Orange County.

Pike, C. (2009). "The Reserve – Outdoor Sustainability Project Flow Monitoring Report." Prepared by GHD Inc. for Municipal Water District of Orange County.

Chesnutt, T.W. (2011). "MWDOC SmarTimer Rebate Program Evaluation." Prepared by A&N Technical Services, Inc. for Municipal Water District of Orange County.

Berg, J.M., Baum-Haley, M., and Chesnutt, T.W. (2012). "Measured Water Savings and Cost Effectiveness of Smart Timers and Rotating Nozzles." 2012 Water Smart Innovations Conference, Las Vegas, NV.

Chesnutt, T.W. (2012). "Evaluation of the Reserves Outdoor Sustainability Project." Prepared by A&N Technical Services, Inc. for Municipal Water District of Orange County.

Chesnutt, T.W. (2012). "Water Quality Analysis for the Reserves Outdoor Sustainability Project." Prepared by A&N Technical Services, Inc. for Municipal Water District of Orange County.

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Appendix B - List of Deliverables

Task	Deliverable by Subtask #	Due Date	Date Submitted
1. PLANS AND COMPLIANCE REQUIREMENTS			
1.1	GPS Information	Day 90	1/7/2008
1.2	Project Assessment and Evaluation Plan (PAEP)	10/2007	12/12/2007
	Non Point Source Pollution Reduction Project Follow-up Survey Form and Assessment of PAEP Status	Annually by 12/30	12/29/2009
1.3	Monitoring Plan (MP)	11/2007	12/12/2007
1.4	Quality Assurance Project Plan (QAPP)	2/2008	3/14/2008
1.6	Copy of CEQA/NEPA Documentation	11/2007	5/9/2007
2. WORK TO BE PERFORMED BY GRANTEE			
2.1.1	Signed Agency Participation Agreements	11/2007	12/12/2007
2.1.2	WUEPE Marketing Materials	1/2008	2/01/2008
2.1.3	List of eligible SmarTimer products WUEPE Program Applications Final WUEPE program Participation Agreement	11/2007	12/12/2007
2.1.5	Inspection and Irrigation System Evaluation Form	1/2008	2/1/2008
2.1.6	Eligible Participant List	1/2008	2/1/2008
2.1.7	Irrigation System Improvement Inspection Form	1/2008	2/1/2008
2.1.8	Copy of Database	11/2012	12/18/2012
2.1.9	WUEPE Education Curriculum	3/2008	2/1/2008
6. REPORTS EXHIBIT B – INVOICING, BUDGET DETAIL, AND REPORTING PROVISIONS			
6.2	Grant Summary Form	Day 30	1/30/2008
6.3	Natural Resource Project Inventory (NRPI)	Before final component invoice	11/2012
6.4	Draft Component Report	11/2012	12/18/2012
6.5	Final Component Report	12/2012	1/23/2013

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Appendix C - Sub-contractor Information

Mission Resource Conservation District (Mission) has been under contract with MWDOC since 2008 to provide landscape audit/device installation services for a variety of irrigation system devices. Mission, as a Non-Profit Special District, and an arm of the Natural Resource Conservation Service, is uniquely qualified to perform irrigation audits and device installation verifications. They have many years experience in both the urban and agricultural setting and provide MWDOC with highly competitive rates.

Over the term of the agreement, MWDOC directed Mission to perform up to approximately 560 residential and 124 commercial site verification inspections where either smart timers or rotating nozzles were installed. Mission's cost to perform residential device installation verification was approximately $45 to $89 plus a $16 administration fee for each verification. Mission's cost to perform commercial device installation verification was $299 on average for each verification.

During each site visit where a smart timer and rotating nozzles have been installed, Mission will perform the following functions:

- Walking the site with the property owner or person designated by the property owner as the responsible party.
- Verifying the site and contact information for the property.
- Verifying the water account information.
- Verifying the device of record (smart timer or rotating nozzle) is installed and programmed/adjusted properly.
- Logging the smart timer's clock capacity.
- Counting the number of active stations/valves.
- Measuring the irrigated area of the property by meter or irrigation clock.
- Determining the actual turf versus shrub percentage.
- Performing a catch can test to determine the distribution uniformity of the irrigation system.
- Turning on each valve/station to evaluate the condition of the irrigation system.
- Placing two-foot-tall irrigation system repair flags at every point where the irrigation system needs repairing. Flags have a listing of potential repairs, and the inspector identifies the irrigation system issue with a permanent marker.
- Leaving behind proper maintenance and irrigation management literature.
- Providing rebate program literature for MWDOC's other rebate programs.

In order to ensure the objectives of the site inspection are met, MWDOC staff will perform a minimum 5% on-site inspection of Mission's work effort during the actual survey process. These inspections will be conducted as a ride-along as or a surprise visit. For all inspections, MWDOC receives the survey schedule in advance.

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Appendix D - Tables & Graphs or Summarized Numerical Data

Table D-1. Irrigated Areas Stratified by Parcel Sizes

		Control Zone				Retrofit Zone			
Parcel Size Range (Sq Ft)	Count Parcels (#)	Count Parcels Control (#)	Parcels w/ measured area (#)	Average Irrigated Area (Sq Ft)	Total Irrigated Area (Sq Ft)	Count Parcels (#)	Parcels w/ measured area (#)	Avg. Irrigated Area (Sq Ft)	Total Irrigated Area (Sq Ft)
< 5000	70	45	6	605	27,233	25	1	518	12,950
5000-5999	87	65	8	1,202	78,114	22	5	2,067	45,470
6000-6999	84	36	5	2,273	81,814	48	19	1,571	75,397
7000-7999	88	16	2	2,285	36,560	72	25	2,073	149,262
8000-8999	43	9	2	4,165	37,485	34	5	2,491	84,687
9000-9999	26	6	2	3,639	21,831	20	8	3,459	69,174
10000-10999	7	1	1	5,568	5,568	6	3	3,125	18,748
11000-11999	9	2	2	4,588	9,177	7	2	4,810	33,670
>12000	5	0	0	0	0	5	4	5,354	26,768
Totals	419	180	28	24,325	297,781	239	72	25,466	516,126

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Table D-2. Irrigation Characteristics of The Reserve Sustainable Study Area

Study Area Characteristics	Units	Control Zone	Retrofit Zone	Study Zones Total
Gross Surface Area	Acres	57.7	103.3	161
HOA Irrigated Area	Acres	26.34	39.30	65.64
Areas of Residential Parcels	Sq Ft	1,069,809	1,772,576	2,842,386
Retrofitted Customer Parcel Area	Sq Ft	NA	571,405	
Customer Irrigated Area	Sq Ft	297,781	516,126	813,907
All Customers Irrigated Area as % of Parcel Area	%	28%	29%	
All Customer Irrigated Area as % of Total Customer Irrigated Area in Both Zones	%	37%	63%	
Retrofitted Customer Irrigated Area	Sq Ft	NA	178,341	
Retrofitted Customer Irrigated Area as % of Parcel Area	%	NA	31%	
Number Residential Customers		180	239	419
Number Retrofitted Customers		NA	72	72

Table D-3. ETo Requirement (from CIMIS Spatial) per 1000 Square Feet

	CIMIS Spatial ETo	ETo Requirement per 1000 Sq Ft of Irrigated Area	Notes
Units	**Inches**	**CCF**	
Period			
Annual 2008	48.34	40.3	
Annual 2009	47.44	39.5	
Annual 2010	45.1	37.6	
2008 Apr 27 – Aug 30	22.44	18.7	Control stormwater & HOA meter read periods
2009 May 26-Sept 30	22.69	18.9	HOA meter read period
2009 June 16-Sept 30	19.64	16.4	Retrofit stormwater flow period
2009 July17-Sept 30	14.1	11.8	Control stormwater flow period

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Table D-4. Home Owners Association Water Use per Unit Area

Water Use		Control Zone	Retrofit Zone
2008: Apr 27 to Aug 30			
HOA applied water [1]	CCF	9207	14202
HOA applied water per 1000 Sq Ft	CCF/1000 Sq Ft	8.0	8.3
ETo per 1000 Sq Ft	CCF/1000 Sq Ft	18.7	18.7
2009: May 26 to Sep 30			
HOA applied water	CCF	11667	17634
HOA applied water per 1000 Sq Ft	CCF/1000 Sq Ft	10.2	10.3
ETo per 1000 Sq Ft	CCF/1000 Sq Ft	18.9	18.9

Table D-5. Customer Water Use per Unit Area

	Units	Control Zone	Retrofit Zone	Irrigation Retrofit Customers
All Customer Consumption April 27-August 30, 2008	CCF	10307	16013	6675
Customer Consumption June 16-Sept 30, 2009	CCF	10928	17388	5310
Total Irrigated Area	1000 Sq Ft	297.7	516.4	178.3
2008 Days of Use Apr 27-Aug 30	days	125	125	125
2009 Days of Use June 16-Sept 30	days	107	107	107
2008 Consumption per Irrigated Area Per Day	CCF per 1000 Sq Ft per day	0.28	0.25	0.30
2009 Consumption per Irrigated Area Per Day, June 16-Sept 30	CCF per 1000 Sq Ft per day	0.34	0.32	0.28
Measured Storm Drain Flows 2008	CCF	1507	NA	NA
Measured Storm Drain Flows 2009	CCF	2039	2289	NA
2008 Storm Drain Flows as % of Consumption	%	15%	NA	NA
2009 Storm Drain Flows as % of Consumption	%	27%	13%	NA

[1] All water consumption data provided by the City of San Clemente.

Table D-6: Mean Net Water Savings by Month Reveals a Seasonal Pattern

Month	*Mean Net Savings by Month*
January	66.6
February	51.1
March	33.4
April	12.5
May	-1.2
June	-5.8
July	0.3
August	13.4
September	35.3
October	54.0
November	68.4
December	72.9

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Appendix E - Photos

The following before and after pictures provide examples from the Municipal Water District of Orange County's Water Use Efficiency Program Expansion projects. Irrigation system and management improvements yield a reduction in water use. Such improvements include installing a smart timer; converting high-precipitation rate fixed spray heads to low-precipitation rate equipment, such as rotating nozzles and drip irrigation; and removal of non-functional turfgrass to a California-Friendly landscape. In addition to water savings, this results in an increase in uniformity, a reduction in pressure, precipitation rate, and overspray/runoff.

Figure E-1. (A) Typical residential landscape with a standard irrigation controller and fixed spray heads This site has a 0.60 distribution uniformity, 3.63 in/hour precipitation rate, 95 psi pressure, and 41 ft of overspray/runoff. (B) Retrofitting the site with a smart timer and rotating nozzles results in 0.65 distribution uniformity, 0.44 in/hour precipitation rate, 40 psi pressure, and 20 ft of overspray/runoff.

Figure E-2. (A) Non-functional turfgrass area with a 0.44 distribution uniformity, 2.4 in/hr precipitation rate, and 40 ft of overspray/runoff. (B) California-friendly landscape with smart timer and rotating nozzles results in 0.65 distribution uniformity, 0.63 in/hr precipitation rate, 12 ft of overspray/runoff, and 100 ft^2 of turfgrass removed.

Figure E-3. (A) Non-functional turfgrass area with a 0.18 distribution uniformity, 85 psi pressure, and 30 ft of overspray/runoff. (B) California-friendly landscape with smart timer and drip irrigation results in 0.95 distribution uniformity, 25 psi pressure, 0 ft of overspray/runoff, and 149 ft^2 of turfgrass removed.

Figure E-4. (A) Non-functional turfgrass area with a 0.38 distribution uniformity, 1.3 in/hr precipitation rate, 22 psi pressure, and 45 ft of overspray/runoff. (B) California-friendly landscape with smart timer and drip irrigation results in 0.90 distribution uniformity, 1.8 in/hr precipitation rate, 30 psi pressure, 0 ft of overspray/runoff, and 262 ft^2 of turfgrass removed.

Figure E-5. Example smart timer installed at a residential site to increase irrigation management.

Figure E-6. Example of inefficient irrigation resulting in runoff, at this site the fixed spray heads were operating at pressure too high and set to run for too long. Through the Water Smart Landscape Project, management increases by the use of a smart timer and water use, precipitation rate, and runoff is reduced by retrofitting with rotating nozzles.

Figure E-7. Example of a zero-turfgrass California-Friendly Landscape.

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Appendix F – Outreach Material

Figure F-1. OC Family Magazine advertisement in September 2008 thru January 2009 issues.

Figure F-2. OC Metro Magazine advertisement in August thru December 2008 issues.

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Figure D-3. OC Weekly Magazine advertisement July 2008 thru September 2008.

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Figure D-4. The Reserves Study door hanger solicitation.

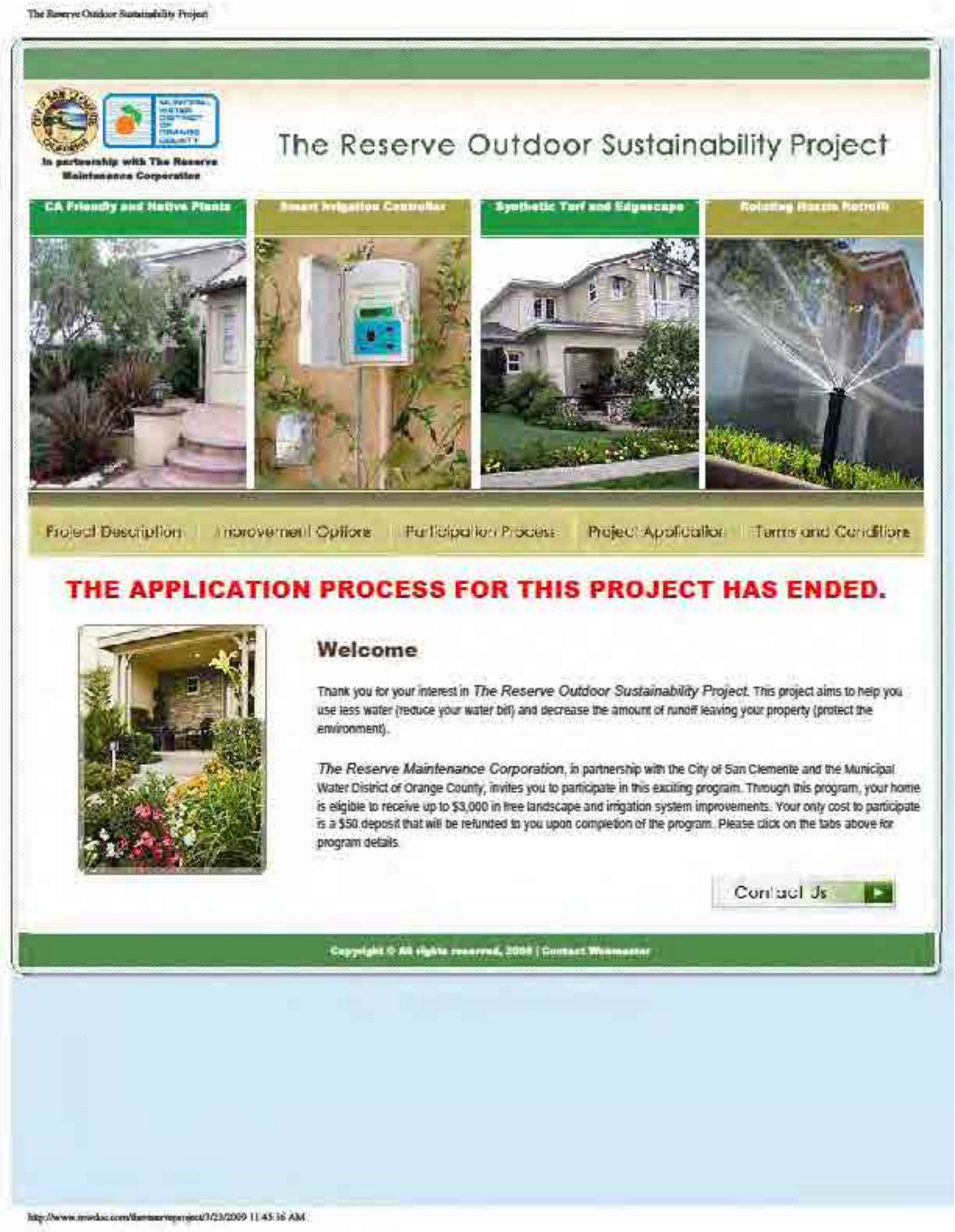

Figure D-5. The Reserves Study website solicitation.

Figure D-6. The Reserves Study direct-mail postcard solicitation.

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State of California—The Resources Agency
DEPARTMENT OF FISH AND GAME

INSTRUCTIONS FOR COMPLETING THE SCIENTIFIC COLLECTING PERMIT (SCP) APPLICATION

APPLICATION

Please read all instructions before completing the application. Incomplete applications will be returned and will delay the issuance of your SCP. Remember to sign and date your application. **SCPs are issued to individuals and are not transferable. You may not conduct collection activity until you have received an approved validated SCP.**

The application is available at www.dfg.ca.gov/licensing/pdffiles/fg1379.pdf. Contact the License and Revenue Branch by telephone at (916) 928-5849 or e-mail spu@dfg.ca.gov if you need additional information. Send your request for SCP Laws and Regulations, SCP Application, SCP Amendment Form, Special Animal List or California Native Species Survey Form to the DFG, License and Revenue Branch, 1740 N. Market Blvd., Sacramento, CA 95834 or download them from our web site at the www.dfg.ca.gov addresses listed on this page.

IMPORTANT! Please allow a **minimum of 12 weeks** for processing any application or amendment to an existing SCP. You should allow an **additional 12 weeks** to process requests to take State Fully Protected Species. The application will become your SCP when validated and returned to you.

STATE AND FEDERAL LAWS AND REGULATIONS

It is important that you read the SCP Laws and Regulations regarding scientific collecting, so that you have a thorough understanding of the requirements. The laws and regulations are available at www.dfg.ca.gov/licensing/pdffiles/fg1476.pdf. Please note that California Fish and Game Code Section 45 includes invertebrates in the definition of “fish”. Therefore, a SCP is required to collect native mollusks and native terrestrial/aquatic invertebrates.

If you wish to take any federally Threatened or Endangered species, **you must include a copy of your current federal permit(s) with this SCP Application**. If you wish to take any State Threatened, Endangered, Fully Protected or Special Concern species, **you must include a copy of any current State-issued permit(s) with your SCP application**.

If you wish to take (capture, release, sacrifice, salvage or marking, including banding) any birds protected by the Migratory Bird Treaty Act, **you must attach a copy of all current federal permit(s) authorizing this activity with your SCP application**.

Plants that are listed under the California Endangered Species Act may require a permit for take for research purposes; however, the SCP is not the appropriate permit for this activity. Additional information on plant permits is available at www.dfg.ca.gov/habcon/plant/plants.html or by contacting the DFG, Habitat Conservation Branch at (916) 653-4875. A SCP is not needed to collect freshwater aquatic plants.

RELOCATION OF SPECIES

The SCP does **not** authorize animal relocation for non-scientific purposes. The SCP is not appropriate to authorize relocation of animals as part of California Environmental Quality Act (CEQA) mitigation or movement of animals “out-of-harm’s way”. Relocation authorization for CEQA mitigation must be obtained by contacting the local DFG regional office prior to handling or relocating wildlife. The list of DFG regional offices is available at www.dfg.ca.gov.

JUSTIFICATION

You must provide justification in Section 4 for every wildlife and activity circled in Section 3. Describe details of all of your requested activities in the justification section. Attach additional pages if necessary. A DFG biologist will determine whether additional documentation or written authorization is required. Animals designated as Threatened, Endangered, Fully Protected, and Special Concern species are Standard Exceptions to routine take with the SCP. These animals are included on the Special Animals list available at www.dfg.ca.gov/biogeodata/cnddb/pdfs/spanimals.pdf. Standard Exception species may be incidentally captured and released only while conducting documentation and identification activities (presence/absence surveys). If you wish to conduct activities on Standard Exception species other than, or in addition to, incidental capture and immediate release, such as marking or telemetry, you will need additional written authorizations on your SCP. Please include additional justification for Standard Exception species and/or methods not included in the numbered authorizations on the back of the SCP application. You must specify in your justification statement what activities you intend to conduct for each Standard Exception species.

PERMANENT IDENTIFICATION NUMBERS FOR SCIENTIFIC COLLECTING PERMITTEES

Each permittee will be assigned a permanent Scientific Collecting Identification Number (SCIN). The SCIN is prefaced with SC- followed by six digits and can be found at the top of the SCP. Use your SCIN on all Scientific Collecting Permits forms and documents submitted to the DFG. Remember to mark all traps with your SCIN that are used under the authority of your SCP.

REPORTING REQUIREMENTS

Section 650(i), Title 14, of the CCR requires that SCP permittees submit a Report of Specimens Collected or Salvaged (RSCS) (FG1379a) within 30 days of the expiration of the permit or upon submitting an application to renew a SCP. The RSCS and instructions for completing it are available at www.dfg.ca.gov/licensing/pdffiles/SC_REPT.xls in a fill and save format. Upon completion of this electronic RSCS, print a copy and attach it to your SCP renewal application or you may send an electronic copy to the License and Revenue Branch at spu@dfg.ca.gov. **Each individual to whom a SCP is issued must provide their own Report of Specimens Collected or Salvaged. If you are not renewing your permit, you are still required to submit a final report within 30 days of the expiration of your permit.**

If you did not collect any specimens or collected the same individuals as another permittee, you still need to submit a report. Enter a single line indicating that no specimens were collected or indicate the permittee's name and SCP number for the specimens already reported. **DO NOT DUPLICATE DATA**.

The DFG also requires that you record your field observations of Threatened, Endangered, or Special Concern species for addition to the Natural Diversity Data Base. The California Native Species Survey Form and instructions for completing it are available at www.dfg.ca.gov/biogeodata/cnddb/submitting_data_to_cnddb.asp.

ADDITIONAL CONDITIONS, AUTHORIZATIONS, AND APPROVALS

If the DFG uses this page for additional conditions, authorizations, and approvals, they become a part of your permit.

AMENDMENT

You are required to complete and submit a Scientific Collecting Permit Amendment Form when requesting a change to an existing SCP or your affiliation changes. The amendment form and instructions for completing it are available at www.dfg.ca.gov/licensing/pdffiles/fg1379e.pdf. **YOU MAY NOT BEGIN NEW COLLECTION ACTIVITY UNTIL YOU HAVE RECEIVED AN APPROVED VALIDATED AMENDMENT.**

CHECK LIST FOR NEW OR RENEWAL APPLICANTS

Remember to…

- Complete, sign and date Page 1 and 2 of the application (FG1379).
- Provide a copy of your current federal permit(s) if required and any other written State authorizations such as a current MOU, if applicable.
- Submit a cashier's check, money order, or personal or business check*. If paying by credit card**, complete, sign and date a credit card authorization form.

APPLICANTS RENEWING A SCP MUST ALSO:

- Complete a detailed justification, even if it is the same as the previous permit.
- Review the preprinted information carefully, line through incorrect information, add corrections and provide information required to complete the application.
- Enclose a copy of your previous SCP.
- Enclose or submit via email a completed RSCS for the term of your previous SCP.

MAIL your completed SCP application **(ALL THREE PAGES)**, federal permit(s) **if required** along with the appropriate fee* to the DFG, License and Revenue Branch, 1740 N. Market Blvd., Sacramento, CA 95834 or apply in person.

NOTICE

Disclosure Statement—Under Fish and Game Code Sections 2535–2546 and Section 745, Title 14, of the CCR, the Department of Fish and Game is authorized to collect information from applicants to maintain a record of licensure. All information requested on this application is mandatory unless otherwise indicated. An applicant's name and city of residence may be provided to the public if requested. Other personal information submitted on this application may be released for law enforcement purposes, pursuant to court order, or for official natural resources management purposes.

A licensee may obtain a copy of his/her license records maintained by the Department by submitting a written request to the Custodian of Records, Department of Fish and Game, License and Revenue Branch, 1740 N. Market Blvd., Sacramento, CA 95834. All requests must include the requestor's name, address, and telephone number.

PAYMENT POLICY*

The DFG accepts cashier's checks, money orders, personal or business checks or credit cards. If a receipt for payment is needed before the SCP is issued, please notify the DFG when the application is submitted.

***Personal or business checks** will be accepted by the DFG if a name and address are imprinted on the check. Checks returned to the DFG due to insufficient funds will render your permit invalid. The DFG may also deny the issuance or renewal of any permit if a person has failed to reimburse the DFG for the amount due. Any activity performed without a valid permit is a violation of the Fish and Game Code and therefore subject to enforcement action.

****Credit Cards**–Licenses, permits, tags, stamps, or registrations may be purchased with a Visa or MasterCard by completing a Credit Card Authorization form. The form is available at www.dfg.ca.gov/licensing/pdffiles/fg1443.pdf.

State of California—The Resources Agency
DEPARTMENT OF FISH AND GAME

Clear Form

2009 SCIENTIFIC COLLECTING PERMIT APPLICATION

THIS PERMIT IS VALID:	PERMANENT ID NUMBER
FROM _____/_____/_____ THROUGH _____/_____/_____	SC-

2009 SCIENTIFIC COLLECTING PERMIT STAMP
No. _____
Date Issued _____

2009 DUPLICATE
No. 000_____
Date Issued _____

☑ **NEW** ☐ **RENEWAL** - Copy of previous permit and report of specimens captured/salvaged **MUST BE ATTACHED** or application will be returned.

CHECK ONE: ☑ **RESIDENT—$61.25** ☐ **NONRESIDENT—$205.00** ☐ **STUDENT—$20.50—RESIDENT AND NONRESIDENT**

BEFORE COMPLETING APPLICATION: Read instructions (last page), permit descriptions, mandatory conditions, and authorization requested or issued on reverse page of application. **Complete all three pages (FIVE SECTIONS) of the application (sponsor's section may be required).** Type or print clearly.

SECTION 1 - PERMITTEE INFORMATION

FIRST NAME	M.I.	LAST NAME	DRIVER'S LICENSE OR DMV ID NUMBER/STATE
Peter	L	DeSimone	C 5 7 7 6 4 4 5 C A

AFFILIATION	☑ Check here if you want future correspondence mailed to your affiliation.	TITLE	DATE OF BIRTH
National Audubon Society		Sanctuary Manager	02/24/1954

PERMITTEE'S MAILING ADDRESS	DAY TELEPHONE	FAX NUMBER
100 Bell Canyon Road	( ) (949) 858-0509	( ) (949) 858-1013

CITY	STATE	ZIP CODE	E-MAIL ADDRESS
Trabuco Canyon	CA	92679	pdesimone@audubon.org

AFFILIATION'S MAILING ADDRESS	CITY	STATE	ZIP CODE
same as above			

SECTION 2 - SPONSOR INFORMATION

*All students must have at least one faculty sponsor's signature. Individuals who collect on the behalf of an organization they are not affiliated with must have two sponsor's signatures from members of that organization. Elementary and secondary school teachers must have their school principal sign as a sponsor. In some other **rare** cases, the Department may determine a sponsor's signature is needed and request this from the applicant.*

SPONSOR'S FIRST NAME	M.I.	LAST NAME	DAY TELEPHONE
			( )

TITLE	ORGANIZATION

MAILING ADDRESS	CITY	STATE	ZIP CODE

SPONSOR'S CERTIFICATION/SIGNATURE: *I verify the take described in this application is required by this organization.* DATE

X

SPONSOR'S FIRST NAME	M.I.	LAST NAME	DAY TELEPHONE
			( )

TITLE	ORGANIZATION

MAILING ADDRESS	CITY	STATE	ZIP CODE

SPONSOR'S CERTIFICATION/SIGNATURE: *I verify the take described in this application is required by this organization.* DATE

X

SECTION 3 - PERMIT INFORMATION

USE OF PERMIT: CHECK BOX(ES)

☐ BIOLOGICAL CONSULTING *(generally, catch and release only)* ☑ RESEARCH ☐ MUSEUM COLLECTION
☐ STATE, FEDERAL OR OTHER AGENCY BIOLOGIST ☑ EDUCATION ☐ OTHER _____

WILDLIFE AND ACTIVITY: **Reminder - You must provide justification in Section 4 for each wildlife and activity circled here in Section 3.**

*Circle the type of wildlife to be taken **AND** circle the type of activity requested: S=sacrifice; R=capture and release; C=take into captivity; SL=salvage; M=mark.*

MAMMALS	S	R	C	SL	M	FRESHWATER FISHES	S	R	C	SL	M
BIRDS *(See "L" on reverse)*	S	R	C	SL	M	FRESHWATER INVERTEBRATES	S	R	C	SL	M
REPTILES	S	R	C	SL	M	ANADROMOUS FISHES	S	R	C	SL	M
AMPHIBIANS	S	R	C	SL	M	MARINE FISHES	S	R	C	SL	M
VERNAL POOL/TERRESTRIAL INVERTEBRATES	S	R	C	SL	M	MARINE AQUATIC PLANTS	S		C	SL	
						MARINE/TIDAL INVERTEBRATES	S	R	C	SL	M

I certify that I have read, understand, and agree to abide by, all conditions of this permit, the applicable provisions of the FGC, and the regulations promulgated thereto. I certify that I am not currently under any Fish and Game license or permit revocation or suspension, and that there are no other legal or administrative proceedings pending that would disqualify me from obtaining this permit. I agree that if I make any false statement as to any fact required as a prerequisite to the issuance of this permit, the permit is void and will be surrendered where purchased, and I understand that I may be subject to prosecution pursuant to FGC Section 1054 or to other administrative actions pursuant to Section 746, Title 14, of the CCR.

SIGNATURE DATE

X

FOR DEPARTMENT OF FISH AND GAME USE ONLY

ALL PAGES OF ATTACHMENTS NOTED IN THIS PERMIT SHALL REMAIN WITH THIS PERMIT AT ALL TIMES.

AUTHORIZATIONS: *(See reverse for explanation)*

DFG APPROVAL(S) SIGNATURE		
1.	2.	3.

REVIEWED BY/DATE	CASHIERED BY/DATE	TRANSACTION #	ISSUED BY/DATE

LRB ROUTED TO/DATE:

1.	2.	3.

PERMIT MUST BE IN IMMEDIATE POSSESSION WHILE COLLECTING

SCIENTIFIC COLLECTING IS NOT ALLOWED UNDER THE AUTHORITY OF A SPORT FISHING LICENSE

State of California—The Resources Agency
DEPARTMENT OF FISH AND GAME

2009 SCIENTIFIC COLLECTING PERMIT JUSTIFICATION

THIS PERMIT IS VALID:	PERMANENT ID NUMBER
FROM _____/_____/_____ **THROUGH** _____/_____/_____	**SC-**

SECTION 4 - PERMIT JUSTIFICATION - Required for **ALL** activities, including permit renewals.

FIRST NAME	M.I.	LAST NAME	☐ CHECK HERE IF PROPOSING TO TAKE STANDARD EXCEPTIONS
Peter	L	DeSimone	

REMINDER - You must provide justification here in Section 4 for each wildlife and activity circled in Section 3.
Use the space below to summarize your research (purpose, methods/techniques, species and numbers to be collected, collection locations, and disposition of specimens). If requesting standard exceptions, marking/tagging, captivity, or sacrifice, specific details as described above must be included for each species and activity requested. Attach additional pages if necessary. Attach copies of appropriate federal permits and additional State permits (e.g., Memorandum of Understanding) to avoid delay of processing. You may be asked to send in a *detailed* study proposal for standard exception species during the review process.

Mist-netting and banding for the purpose of landbird population monitoring and research will be conducted at Starr Ranch Sanctuary (SE Orange County) according to MAPS (Monitoring Avian Productivity and Survivorship) and MoSI (Monitoreo de Sobrevivencia Invernal) protocols developed by the Institute for Bird Populations (IBP), Stinson Beach, California. Passerine and near-passerine species banded will be in accordance with those allowed according to the attached permit. All banding data will be submitted to IBP and to the national data repository at the Bird Banding Lab (BBL) of the Biological Resources Division of the USGS located in Washington, DC. Data submitted to these two sources will be used in nationwide long-term avian demographics studies. Feather samples may be collected from some birds prior to release as part of a West Nile Virus/Avian Flu study conducted by IBP & UCLA. Feather samples will not be collected will be collected from species allowed according to the attached permit.

By checking all boxes, I hereby declare that the following information is provided in the above justification:

☑ Purpose ☑ Species + Numbers to be collected ☑ Collection Locations ☑ Species Disposition
☑ Methods/Activity *(Standard Exceptions)* ☑ Attached Federal/State Permit(s) *(Applicable/Not Applicable - Strike One)*

I understand that if I fail to provide all information, circle items or check the boxes, my application will be denied. I certify that I have read, understand, and agree to abide by, all conditions of this permit, the applicable provisions of the FGC, and the regulations promulgated thereto. I certify that I am not currently under any Fish and Game license or permit revocation or suspension, and that there are no other legal or administrative proceedings pending that would disqualify me from obtaining this permit. I agree that if I make any false statement as to any fact required as a prerequisite to the issuance of this permit, the permit is void and will be surrendered where purchased, and I understand that I may be subject to prosecution pursuant to FGC Section 1054 or to other administrative actions pursuant to Section 746, Title 14, of the CCR.

SIGNATURE	DATE
X	

FOR DEPARTMENT OF FISH AND GAME USE ONLY

DFG APPROVAL(S) SIGNATURE		
1.	2.	3.

State of California—The Resources Agency
DEPARTMENT OF FISH AND GAME

2009 SCIENTIFIC COLLECTING PERMIT ADDITIONAL CONDITIONS, AUTHORIZATIONS, AND APPROVALS

THIS PERMIT IS VALID:	PERMANENT ID NUMBER
FROM _____/_____/_____ **THROUGH** _____/_____/_____	**SC-**

SECTION 5

FIRST NAME	M.I.	LAST NAME
Peter	L	DeSimone

ADDITIONAL CONDITIONS, AUTHORIZATIONS, AND APPROVALS ARE AS FOLLOWS:

FOR DEPARTMENT OF FISH AND GAME USE ONLY

ALL PAGES OF ATTACHMENTS NOTED IN THIS PERMIT SHALL REMAIN WITH THIS PERMIT AT ALL TIMES.

DFG APPROVAL(S) SIGNATURE		
1.	2.	3.

SCIENTIFIC COLLECTING PERMIT DESCRIPTIONS

Resident: Any person who has resided continuously in California for six months immediately prior to the date of application and are either employees of local, state, and federal agencies who take specimens in connection with their official duties; faculty, professional staff, college level students of, or individuals hired by; public or private companies, educational institutions, zoological gardens or aquariums, in or out of state; or individuals who take wildlife or marine plants for other permittees or pursuant to environmental protection documents required by law. Resident SCP's are valid two years from the date of issuance.

Nonresident: Any person who has not resided continuously in California for six months immediately prior to the date of application and are either employees of local, state, and federal agencies who take specimens in connection with their official duties; faculty, professional staff, college level students of, or individuals hired by; public or private companies, educational institutions, zoological gardens or aquariums, in or out of state; or individuals who take wildlife or marine plants for other permittees or pursuant to environmental protection documents required by law. Nonresident SCP's are valid two years from the date of issuance.

Student: Any resident or nonresident student of a college or university for required coursework in wildlife research and sponsored by a faculty member. Student SCP's are valid one year from the date of issuance.

MANDATORY CONDITIONS FOR ALL SCIENTIFIC COLLECTING PERMIT (SCP) HOLDERS

A. **STANDARD EXCEPTIONS TO THE SCIENTIFIC COLLECTING PERMIT:** This permit does not authorize you to take any of the following without an additional, written permit (letter permit or Memorandum of Understanding (MOU)) from the DFG; except as may be authorized in numbered authorizations (see back of page 2) that may have been approved on your permit: (1) All threatened and endangered species (state and federal classification); (2) pelicans, herons, egrets, swans, vultures, raptors, cranes, bird nests and eggs; (3) bats, beaver, carnivores (e.g., foxes, bear, ringtail, raccoon, marten, fisher, mink, badger, otters, mountain lion, bobcat, seals and sea lions); (4) elk, deer, antelope, mountain sheep, and bighorn sheep; and (5) California Fully Protected Species and Special Concern Species.

B. No collections may be made in any Marine Protected Area (www.dfg.ca.gov/mrd/mlpa), State Marine Reserve, State Marine Conservation Area, State Marine Park, State Reserve, Marine Life Refuge, Fish Refuge, Wildlife Area, State Game Refuge, or Ecological Reserve without additional written permission from both the Department and area manager. Tidal Invertebrates may not be taken in any tide pool or other areas between the high tide mark and 1,000 feet seaward and lateral to the low tide mark and any of the places listed above, state beaches, parks, reserves, or recreation areas.

C. Pursuant to California Fish and Game Code, Sections 1002 and 1003, and Section 650, Title 14, of the CCR the permittee is authorized to collect specimens of fish and wildlife according to the conditions listed on this permit. **The permittee must be present and carry this Scientific Collecting Permit and any amendments to the permit at all times when collecting. These forms must be in possession when collecting and must be shown upon request to any person authorized to enforce Fish and Game regulations.**

D. Pursuant to Section 650(i), Title 14, of the CCR SCP permittees are required to submit a Report of Specimens Collected or Salvaged within 30 days of the expiration of the permit or upon submitting an application to renew a SCP, whichever comes first.

E. You must notify the local DFG office of the event and location of your activities prior to collecting. Notification must be made during normal business hours, at least 24 hours prior to collecting and can be made using the Notification of Intent to Collect for Scientific Purposes form available at www.dfg.ca.gov/licensing/pdffiles/fg1379f.pdf.

F. This permit does not relieve the permittee of the responsibility to obtain any other permits, or comply with any other Federal, State, or local laws or regulations. It is the responsibility of the permittee to know the boundaries and managing authority of specially designated protected areas or sanctuaries.

G. No other sport or commercial fishing activities or collection of unauthorized species is allowed on the same trips or time periods as scientific collection activities.

H. You must complete California Native Species Field Survey (CNSFS) forms for any Threatened, Endangered, or Special Concern Species captured. Mail to the address listed on the CNSFS. The CNSFS is available at www.dfg.ca.gov/biogeodata/cnddb/submitting_data_to_cnddb.asp.

I. Once removed from the wild, animals may not be returned to the wild without prior written permission from the DFG.

J. Marking of any kind is not authorized by this permit unless it is specifically requested by the permittee and authorized in writing by the DFG.

K. Use of pitfall traps is not authorized by this permit unless it is specifically requested by the permittee and authorized in writing by the DFG.

L. To band or to take (capture, release, sacrifice, salvage or mark) birds protected by the Migratory Bird Treaty Act, **you must attach a copy of all current federal permit(s) authorizing this activity with your SCP application.**

M. You must mark each trap set to capture mammals with your Scientific Collecting Identification Number (SCIN) before placing the trap in the field. Marking traps with an identification number is a requirement of Fish and Game Code Section 4004. The SCIN shall be stamped clearly on the trap or on a metal tag attached directly to any part of the trap (Section 465.5(g), Title 14, of the CCR). Tagging the trap allows the person to remove the tag before another permittee uses the same trap and attaches his/her own tag.

NUMBER AUTHORIZATIONS REQUESTED BY PERMITTEE / NUMBER AUTHORIZATIONS ISSUED BY DFG

1. You may take or possess marine fishes (excluding salmon, stealhead, striped bass, and sturgeon - request authorization to collect these under **Anadromous Fishes**) **not to exceed sport fishing bag limits; sport fishing seasons and size limits shall apply**. Cowcod, giant sea bass, garibaldi, gulf grouper, broomtail grouper, and white shark may not be taken. Authorized methods of take: hand, hook and line, seine (except beach seine), dip nets, spear, dredge, hand tools, and trap (when marked with Scientific Collecting Identification Number (SCIN)).

2. You may take or possess marine aquatic plants **not to exceed 10 pounds** wet weight in the aggregate. Eel grass, surf grass, and sea palm may not be taken. Authorized method of take: hand and hand tools.

3. You may take or possess marine invertebrates **not to exceed sport fishing bag limits; sport fishing seasons and size limits shall apply**. Lobster, abalone, and live rocks may not be taken. Authorized method of take: hand, hook and line, seine (except beach seine), dip nets, spear, dredge, hand tools, and trap (when marked with your SCIN).

4a. You may take terrestrial invertebrates and vernal pool invertebrates **excluding Standard Exceptions (see Mandatory Condition A)**. Threatened or Endangered Species inadvertently collected shall be immediately released and reported to the Department of Fish and Game (DFG), Wildlife Branch, Scientific Collecting Permit Biologist, 1812 9th St., Sacramento, CA 95811 on copies of California Native Species Survey (CNSFS) forms **(see Mandatory Condition H)** within three business days. Authorized methods of take: hand and net.

4b. You may take aquatic invertebrates from streams and lakes **excluding Standard Exceptions (see Mandatory Condition A)**. Threatened or Endangered Species inadvertently collected shall be immediately released and reported to the DFG at (916) 327-8335 within two business days. Authorized methods of take: hand, net, dip net, Surber sampler, drift net, dredge, and plankton net.

5a. You may capture and release an unlimited number of freshwater fishes, **including Special Concern Species** but excluding all other Standard Exceptions, only for the purposes of identification and documentation. Seasons and size limits shall not apply. Threatened or Endangered Species inadvertently collected shall be immediately released and reported to the DFG at (916) 327-8335 within two business days. Authorized methods of take: hand, hook and line, seine, dip net, and minnow trap (when marked with SCIN). Electrofishing and gill netting are not authorized without express written approval from the DFG office responsible for the area where collections are proposed.

5b. You may sacrifice, as voucher specimens (for the purposes of identification and documentation), up to 3 individuals per species of nongame freshwater fish, **excluding all Standard Exceptions**. Seasons and size limits shall not apply. **All Standard Exception species inadvertently collected shall be immediately released and reported to the DFG at (916) 327-8335 within two business days (see Mandatory Condition H).** Authorized methods of take: hand, hook and line, seine, dip net, and minnow trap (when marked with your SCIN). Electrofishing and gill netting are not authorized without express written approval from the DFG office responsible for the area where collections are proposed.

6a. You may capture and release an unlimited number of amphibians and reptiles, **including Special Concern Species**, but excluding all other standard exceptions, only for the purposes of identification and documentation. All animals captured shall be released alive and unharmed at the capture site and may not otherwise be removed from the wild unless authorized by the DFG. Specimens of Threatened or Endangered Species inadvertently collected shall be immediately released and reported to the DFG, Wildlife Branch, Scientific Collecting Permit Biologist, 1812 9th St., Sacramento, CA 95811 on copies of CNSFS forms **(see Mandatory Condition H)**. Authorized methods of trapping are hand, dip net, minnow seine, lizard noose, snake tongs, snake hook, and live-trap (when marked with your SCIN). You shall report to the DFG's Wildlife Branch at (916) 445-0879 within three days any incidental injury or mortality of individuals of Standard Exception Species.

6b. You may purposefully capture **(see Mandatory Condition M)** and release an unlimited number of small mammals, **excluding all Standard Exceptions**, but only for the purposes of identification and documentation. You shall immediately release all captured individuals alive, unharmed, and unmarked at the site of capture and shall not otherwise handle these animals without additional authorization from the DFG. You shall immediately release any inadvertently-captured individuals of Standard Exception species and report their capture to the DFG, Wildlife Branch, Scientific Collecting Permit Biologist, 1812 9th St., Sacramento, CA 95811 on copies of CNSFS forms **(see Mandatory Condition H)**. You shall also contact the DFG's Wildlife Branch at (916) 445-0879 within three days to report any incidental injury or mortality of individuals of Standard Exception Species. Authorized methods of trapping are live-traps, Sherman- or Tomahawk-brand, of appropriate size to avoid capture of medium-sized mammals or carnivores.

7. You may salvage dead amphibians, reptiles, and mammals. You shall leave specimens that are unsuitable for donation at the site or shall completely destroy them through burial or incineration. You shall obtain additional permission to salvage on private or public property from the landowner or custodian of that property. You shall tag each salvaged specimen with the following information: (a) date of salvage and location of the specimen; (b) name of the person who salvaged the specimen; and (c) the permit number under which the specimen was salvaged. You shall deposit all salvaged specimens in a public scientific or educational institution within one month of acquisition.

8. You may take birds in accordance with your federal permit(s). The DFG may require additional or modified conditions that will be noted on your SCP. You shall immediately release any inadvertently-taken Threatened or Endangered Species and report their capture to the DFG, Wildlife Branch, Scientific Collecting Permit Biologist, 1812 9th St., Sacramento, CA 95811 on copies of CNSFS forms **(see Mandatory Condition H)**.

9. You may take species that are federally-listed or are both State- and federally-listed in accordance with your existing federal permit(s). The DFG may require additional or modified conditions that will be noted on your SCP. If you are using traps to take mammals, you must follow Mandatory Condition M. You shall immediately release any Threatened or Endangered Species not authorized in your federal permit and report their capture to the DFG, Wildlife Branch, Scientific Collecting Permit Biologist, 1812 9th St., Sacramento, CA 95811 on copies of CNSFS forms **(see Mandatory Condition H)**.

State of California – The Resources Agency JERRY BROWN, Governor

FISH AND WILDLIFE WATER POLLUTION CONTRL LABORATORY
OFFICE OF SPILL PREVENTION AND RESPONSE

LIST OF AUTHORIZED INDIVIDUALS
Conducting Macroinvertebrate Bioassessment
COORDINATED WITH
The Office of Spill Prevention and Response's Aquatic Bioassessment Laboratory
AND THE
CALIFORNIA DEPARTMENT OF FISH AND GAME (STATEWIDE)

This Letter of Authorized Individuals (LAI) is made and entered on April 9, 2012 as supplement to the Memorandum of Understanding (MOU) by and between the names listed and the California Department of Fish and Game (Department).

The Department has reviewed the qualifications of the following individual(s) and has determined they are eligible to be designated as Primary Monitor(s) or Field Monitor(s) as described in the MOU:

Names: Scott Gibson – Primary Contact
Starr Ranch Sanctuary
Audubon California
100 Bell Canyon Road
Trabuco Canyon, CA 92679

Supervised individuals may conduct activities under this permit only under the direct on-site supervision of one of the above named individuals.

A copy of the MOU dated May 27, 2010 and Amendment 2 for 2012 must be carried with a copy of this LAI when conducting activities authorized by the MOU. The signature signifies his/her/their understanding of and agreement to abide by the conditions and authorizations of the MOU.

_____
Date

_____
Signature of PM

James Harrington
Staff Environmental Scientist
DFG Water Pollution Control Laboratory
2005 Nimbus Road
Rancho Cordova, CA 95670

_____
Contact Phone Number

This list is only valid if it is dated on or after the MOU issuance date.

Exotic Control Final Report
2011-2012

Mark Paglierani
Jenni Benson

Goals:

Our main goal is the non-chemical removal and control of four invasive species throughout riparian and roadside habitats in Bell Canyon. We will work to remove three exotics of concern: periwinkle (*Vinca major*), English ivy (*Hedera helix*), and smilo grass (*Piptatherum milaceum*) from 0.5 new acres along Bell Creek. If time allows, we will work on removing and controlling other exotics prioritized from mapping in Crow Canyon. Roadside exotics that will be controlled along Bell Canyon Road include English plantain (*Plantago lanceolata*) in addition to periwinkle and smilo grass. The roadside project will begin at the north end of Bell Canyon Road and will continue southward. Additionally, we will maintain 4.25acres that were previously removed of exotics by interns and members of the Orange County Conservation Corps (OCCC).

Protocol: (control methods were developed by previous Starr Ranch interns from 2005-07)

Periwinkle (*Vinca major*) is a spreading perennial vine that sends roots 6-12 inches into the soil and can reproduce either by sending out stolons at the root tips or from stem and root fragments. Therefore, it is very important not to tear the root crown and to remove the entire root mass during plant removal. A weeder digger will be used to loosen the soil around the roots of *Vinca major*, in order to properly remove the root system without tearing. All of the plant material will then be collected in bags and/or on tarps and disposed of at the Starr Ranch brush pile (1).

English ivy (*Hedera helix*) is a climbing evergreen vine that attaches itself to various surfaces (such as trees) by way of numerous root-like structures. When removing English Ivy from a tree, be careful not to damage the tree. Loppers are used to cut the vines both at shoulder and ankle heights, but hand saws or chain saws may be used in the case of thick, woody vines. The vines and all fragments are then removed from the tree by stripping and prying and are pulled away to the point where they are rooted in the ground. Moving outwards from the base of the tree, the vines are pulled until a 2m wide patch of ground around the tree is cleared. The Log Roll method can be implemented if enough room is available. This involves two people pulling the vines backwards to form a log-shaped bundle until the log is too large to roll any further. The edges are then lopped and another log roll is started. If the Log Roll method cannot be employed, weeder diggers or loppers can be used to remove the vines from the soil. A weed wrench can also be used for control because it grips roots deep in the soil and then lifts them out by way of a lever action. Additionally, a mini-tiller can be used for clearing brush and prying up roots. To dispose of the plant material, gather the pulled ivy, ensuring no nodes are left in contact with the soil, onto a tarp for transportation to the Starr Ranch brush pile (2).

Smilo grass (*Piptatherum miliaceum*) is a perennial grass that thrives in a variety of conditions on Starr Ranch. It is removed by pick mattocks, loosening the root crown so that the entire root ball can easily be lifted up. The plant material is placed on a tarp and then transported to the Starr Ranch brush pile (3).

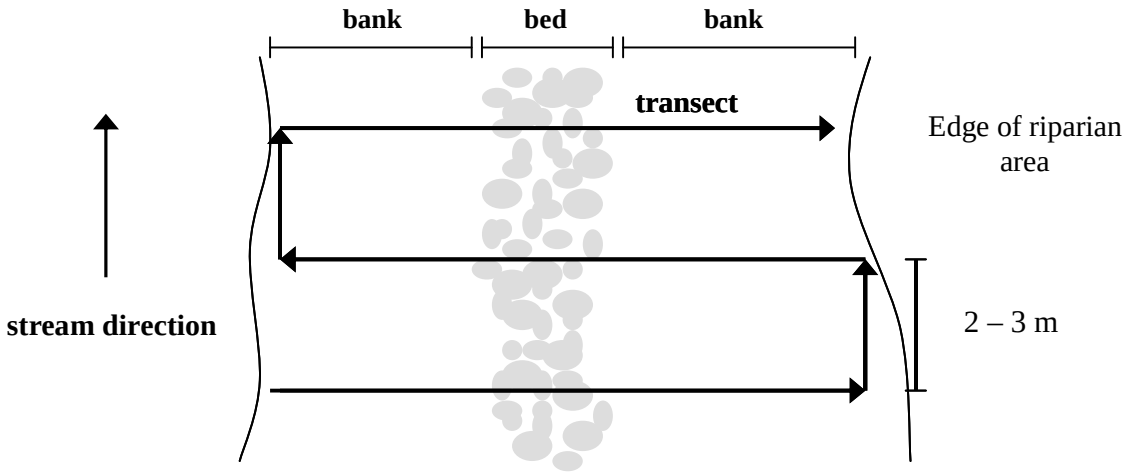
English plantain (*Plantago lanceolata*) can also be found in many habitats at Starr Ranch. Most frequently, it can be fully removed by using a weeder digger to pry up the tap root. Its leaves can also be cut to the ground with a brush cutter and/or hoe so as to starve the roots.

Exotic control will be performed 2.5 days/week as follows:

Maintenance (4.25 acres): 1 day/week

(a) Before photos will be taken in areas with high exotic cover (i.e. where exotic species returned after previous control).

(b) We will walk transects across Bell Canyon Creek, from one bank to the other (as seen in the figure below), removing all exotic species encountered. Once transects are completed for the day, endpoints will be marked with colored wire flags (which will then be removed when transects are restarted and placed at the new endpoints). In order to limit exotic seed transfer (LEST), LEST buckets will be used to remove seeds from boots and clothing upon exiting the transect site.



New Acreage (0.5 acres): 0.5 day/week

Enhancement Areas (5): 0.5 day/week

Roadside (Bell Canyon Road): 0.5 day/week

Miscellaneous Exotic Control: 0.5 days/week on any of above

Bell Canyon Creek walks (see separate work plan) OR other exotic control biweekly

All work hours and other data as well as any equipment purchased will be recorded at the end of each work day in "Intern Hours and Expense Data."

Data Collection Form and Frequency:

Maintenance acreage (4.25 acres in which exotics were removed from 2006-11 by interns, other staff, volunteers, and the Orange County Conservation Corps and 15 passive monitoring plots): 1 day/week

(a) Photopoints: before photos will be taken from a point marked temporarily with a color wire flag, and after photos will then be taken from the same point after control is completed. If time allows, pictures should also be taken during the project.

Save photos in jpeg format in the Public: Digitals & Scans/ISC&R Upland and Riparian/Riparian&Rdside ISC&R/2011-12 in Before, During, and After folders.

New acreage (0.5 acres): half day/week

(a) To be decided with Sandy: the number of macroplots for quantitative passive monitoring as per 2008-09 protocol in new areas and method of qualitative (i.e. photopoints) monitoring.

Results

Table 1. Summary of total hours worked, areas covered and work rates per person.

	Total Intern Hours	Total Volunteer Hours	Total Hours	Area Covered (m2)	Area Covered (acres)	Work rate per person (m2/hr)	Work rate per person (acres/hr)
Maintenance	166.50	160.25	326.75	2898.06	0.72	8.87	0.0022
Roadside	145.00	239.75	384.75	6828.52	1.69	17.75	0.0044
Enhancement	11.00	3	14.00	1132.90	0.28	80.92	0.0200
New	105.50	223	328.50	353.20	0.09	1.08	0.0003
Total	428.00	626	1054.00	11212.68	2.78		

Table 2. Summary of 2010-2011 New and Maintenance work rates

2010-2011	Work rate per person (m2/hr)	Work rate per person (acres/hr)
New	5.29	0.0032
Maintanence	13.92	0.00131

Table 3. Summary of area worked in comparison to goal for 2011-2012.

	Goal (acres)	Area covered (acres)
Maintanence	4.25	0.72
New	0.5	0.09

Figure 1. Photo-monitoring of a maintenance site behind the conference room; the picture on the left was taken before exotic control was performed and the picture on the right shows the same site after the removal of periwinkle.

Figure 2. Photo-monitoring of a new site south of the brush piles; the picture on the left was taken before exotic control was performed and the picture on the right shows the same site after the removal of periwinkle.

Figure 3. Photo-monitoring of before and after exotic control of periwinkle in a new site south of Enhancement 4. Top two photos are taken from the upper bank of this site and the bottom two are taken from a lower bank looking up. Note the green right of center in the bottom after photo: these are native plants (mugwort, hedge nettle, and ragweed) which have re-colonized the northern corner of this site and are still moving in.

Discussion

Periwinkle has a variety of growing styles based on the site and soil that it is growing it. It can form dense clumps with large root balls or grow in a spindling singular form. The closer you get the creek, water, and looser sandy soil, the easier it becomes to pull periwinkle. We found that using a weeder digger for prying up smaller patches and deeper roots worked well. For denser areas of periwinkle the mini pick-mattocks worked very well either using the forked end to sink in and pry up or the solid pointed end to do the same. One of our volunteers, Bob Wright developed a technique to clear dense periwinkle patches. This technique involved sitting down cross-legged facing a patch of periwinkle. You would begin to dig a trench around the periwinkle with your hands and also with the mini pick mattock and begin to dig under the clumps of periwinkle roots. Once a large chunk of roots is exposed you can stick the forked end of the mini pick mattock under the clump, with the handle pointing toward the sky and begin loosening the root clump by pushing, wiggling and prying with the pick mattock. This is an efficient technique for anyone willing to try it and it becomes easier as you do it more. The techniques stated in the methods sections also proved effective with removal of smilo grass, English plantain, and English ivy.

Looking at our goals of maintaining 4.25 acres and weeding 0.5 acres it is obvious that we fell short of those goals, only maintaining 17% and weeding 18% of our target goals. One of the possibly dominant reasons

for our lack of exotic control acreage in maintenance and new areas was that we added an additional half day of roadside control a week, but called it upland plantago maintenance and we also devoted more time to doing a weekly Bell Creek Walk which was at least a half day almost every week. We took at least three very large Weed Warrior groups up to the site 9 area to weed plantago and we feel that our acreage numbers for new and maintenance would be different if we had taken these groups to new or maintenance sites. These large groups added significant volunteer hours to roadside maintenance and, coupled with the large areas walked on the road and the upland sites, gave us some large numbers. Additionally, we took several Weed Warriors groups back to maintenance sites that we had already weeded this year because we noticed that periwinkle was re-sprouting in sites like the two across from the conference room. This may help to explain the relatively high number of hours logged by interns and volunteers at maintenance sites with a lower area covered per hour.

In the new areas, we had very dense periwinkle cover which may explain the lower work rate to high hours which were spent there. Many of our Weed Warriors were new-comers and often worked slower than the more experienced weed pullers. However, one of our Weed Warrior groups that helped weed our new passive site 16 came a day or two after some heavy rains. The soil in this site was wet and loose and it was quite easy to pull large clumps of periwinkle. This was perhaps our most productive day of weeding in a new site.

As far weeding enhancement sites, we covered all of the enhancement sites in a short amount of time, at a total of 14 hours. There was not a large quantity of smilo, periwinkle, or English ivy at these past enhancement sites. In fact, these sites had filled in with a large amount of natives that may have crowded out our target exotics and we were able to cover a large area in a short time, which explains the work rate of about 81 square meters per hour.

Throughout the 7 ½ months we worked in the riparian, we tried to keep up with our 2.5 days a week of exotic control. Unfortunately we were not able to adhere strictly to this 2.5 days per week of maintenance, roadside, new, and enhancement because of other obligations from our enhancement, Weed Warriors, and/or Bell Creek walks. Also, we devoted a considerable amount of time to upland plantago although it was technically considered “roadside.” This was a confusing and unintended notion that we had not considered and we believe that Sandy and the interns next year should determine what to consider this work so that it is not confused with something else and there is ample time to give to the 2.5 days of exotic control.

Another recommendation that we have is about repeat weeding in new and maintenance sites. Over the course of this year we felt that it was important to re-weed sites that had lots of post weeding periwinkle sprouts such as the maintenance areas across from the conference room and our new sites. So, as a result, we went back to and brought back Weed Warriors (especially if they were smaller groups) to already-weeded sites from this year to catch re-sprouting periwinkle roots that may have taken over the site by next year. These repeat site visits raised the hours worked to area covered and do not account for revisited sites in terms of area. In the future, interns may want to talk to Sandy about this issue and see if it is worth revisiting sites of that same year. Also, when adding up area for sites, revisited sites could possibly be counted twice if, say, they were weeded twice with a Weed Warriors group.

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Riparian Enhancement Report
2011-2012

Mark Paglierani
Jenni Benson

Background:

A riparian habitat is characterized by a unique set of physical and ecological factors influenced by the flow and potential floodplain of a river. These factors include nutrient rich soil, dependable access to water, and flora and fauna that are adapted to regular flooding. In the state of California, riparian habitats have been found to support more species of wildlife than any other vegetation type, emphasizing the importance of these areas. Streams and rivers also function as a corridor for the movement of wildlife, in addition to both native and exotic plant dispersal (7). As a result of this dispersal, much of the riparian habitat in Starr Ranch, specifically along Bell Creek, is being overtaken by invasive plants such as periwinkle, smilo grass, and English Ivy.

Periwinkle (*Vinca major*) is a spreading perennial vine found in the majority of the riparian corridor of Bell Canyon (8). Large patches of periwinkle have been removed since 2006 by interns, volunteers, and the Orange County Conservation Corp (OCCC). The removal results in large areas of bare ground become prone to erosion and the invasion of new exotic species, making these areas ideal locations for both active and passive enhancement sites (2). Passive enhancement would be ideal because it takes less time, effort, and money; however active enhancement greatly accelerates the re-establishment of native species. Revegetation can be accomplished through seeding and/or cuttings, with cuttings being the better option because it establishes viable plants faster than seeding (4). Riparian zones are considered high disturbance systems and the species that live in them establish naturally by fragmentation, making revegetation fairly easy to achieve in riparian habitats (2, 6). The species selected for planting in each enhancement site must be located in or adjacent to the removal area.

The first enhancement site was established in 2006-2007 north of the main house on the west bank and focused on the propagation of *Rubus ursinus* (California blackberry), *Vitis girdina* (wild grape), *Alnus rhombifolia* (white alder), and *Platanus racemosa* (western sycamore), and examined the effects of high vs. low irrigation and the presence or absence of herbivore exclosures (6). The data indicated that higher levels of irrigation resulted in greater success, with a suggestion of daily watering for the first two weeks after the cuttings were planted and watering at least three times per week after the first month (1, 2). The results also indicated that the diameter of the cuttings had no effect on viability and suggested a minimum diameter of 3/8” (2). It is important to note that in the summer of 2007, the irrigation to site 1 was accidentally turned off, causing a large portion of the cuttings to die.

Enhancement 2 (2007-2008) is located just south of the bridge on the east bank and *Salix spp* (willow), *Baccharis salicifolia* (mulefat), and *Artemisia douglasiana* (mugwort) were used for cuttings. For willow and mulefat, just cuttings were planted, but for mugwort, both cuttings and rhizomes were used. Mulefat and mugwort (both rhizomes and cuttings) were soaked in a willow mixture for 2-3 days and all plants (*Salix* included) received

the same watering treatment of watering every day for the first two weeks and every other day thereafter, adjusted for rain (3). *Baccharis* and *Salix* cuttings were both successful with 94% and 92% of cuttings, respectively, surviving 2.5 months, however only 3% (one of thirty) *Artemesia* cuttings survived. The mugwort rhizomes had more success than the cuttings with 57% sending up at least one shoot after 2.5 months and more specifically the rhizomes with fewer side roots had more success than those with more side roots (4). It was also noted that mugwort rhizomes were difficult and time consuming to collect (4).

In 2008-2009 Enhancement 3 was planted just north of the bridge on the east bank, used *Baccharis salicifolia, Salix spp, Rubus ursinus,* and *Platanus racemosa,* and examined the effects of high vs. low irrigation levels and soaking the cuttings in the standard mixture compared to soaking in willow tea. The standard treatment consisted of the cuttings (by species) being soaked in buckets of water that contained willow stems, whereas the willow tea involved cutting willow stems into inch long pieces, smashing them with a hammer, and steeping them in water. It was found that plants that received lower levels of irrigation had greater success and was thus recommended that plants be watered daily for the first two weeks and then for 15 minutes once daily (as opposed to twice daily) thereafter. It was also determined that not only was the willow tea method more time consuming, but resulted in lower success; furthermore, the necessity of soaking the cuttings at all was questioned (2).

The fourth enhancement site is located south of the first creek crossing on the west bank and focused on planting *Baccharis salicifolia, Platanus racemosa, Rubus ursinus, Artemisia douglasiana,* and *Vitis girdina*. The 2009-2010 interns had high survival rates for their cuttings, which they mostly attribute to the higher light levels of their site. They recommend using mugwort rhizomes over cuttings if time is available for the collection of rhizomes. It was noted that *B. salicifolia, P. racemosa,* and *R. ursinus* had a steady increase in leaf production, however *V. girdiana* developed leaves much later than other species (1).

One of the 2010-2011 enhancement sites was located in Enhancement site 1 in the SRJB sampling area, north of the main house on the west bank of Bell Creek. This site had a very low success rate for cuttings, and almost none of them survived. This may have been because of low light levels in this site, but could also be attributed to a number of other factors. The second 2010-2011 site was located Enhancement site 2 south of the bridge on the east bank. *Baccharis salicifolia* was successful in establishing viable individuals despite the floods that occurred that year. The third and last enhancement site from the 2010-2011 year was located in Enhancement site 3, just north of the bridge on the east bank.

Goal: Our goal is to establish native riparian species in areas that were previously disturbed by Starr Ranch flood mitigation projects and prevent the colonization of undesirable exotic plant species (specifically *Vinca major*).

Methods & Design: (methods modified from Cincotta and Dobson, Ackerman and Breen protocols)

Layout: Our sites are located on the north and south sides of the conference room in an area that was heavily disturbed by the construction of stone gabions in September 2011. The areas around the conference room have since been graded and leveled with fill and they contain no exotics to remove. The site north of the conference room- labeled Cuttings Area A, will contain 36 cutting plots that contain five cuttings each (see Figure 2) and the site South of the conference room- Cuttings Area B, will consist of 4 plots of the same design (see Figure 1 below). Species were placed based on relative correspondence with riparian zone classifications. These two sites receive a reasonable amount of uniform sunlight throughout the day, therefore we considered light exposure to be less of a factor in cutting success than moisture requirements and slope position. We selected species based on general suggestions from the Guide to Native and Invasive Streamside Plants (11) and the stratifications of species by riparian zone(s). Mulefat and mugwort were placed closer to the gabions on the lower end of the slope, blackberry was placed further up, and sycamore was placed highest and furthest from Bell Creek. We placed grape close to the gabions with the hopes that this vine species would colonize the gabions, grow over them, and eventually connect sites A and B to one another. A possible consequence of grape succession could be the shading out of the seeded species within the enhancement site between sites A and B, however no concrete future can be determined at the time of planting.

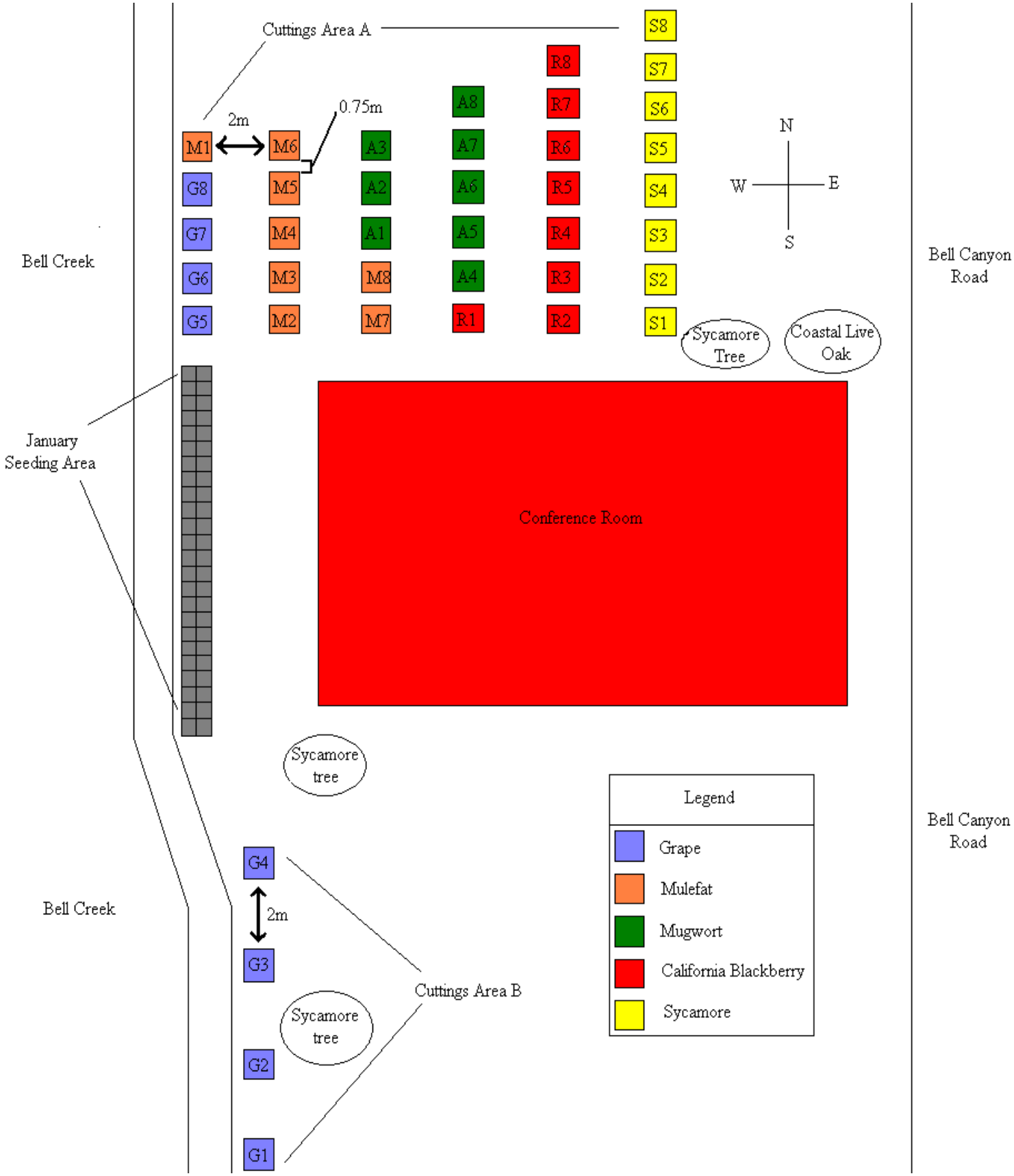

Figure 1. Layout for February cuttings areas (diagram not to scale)

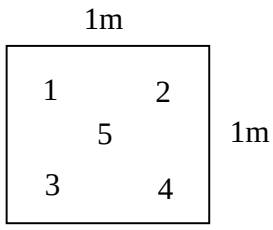

Figure 2. Diagram of the 1x1m blocks with number labeling for each plant location within the block. Each plot will have 5 cuttings of the same plant species with equal spacing

Table 1. Light, moisture, and soil requirements for native species that will be planted (1). TOE: toe-of-slope; LB: lower bank; MB: middle bank; UB: upper bank; UP: upland (9). Light scale from most sun to least 5-1.

Common Name	Scientific Name	Light requirement	Water requirements	Soil Types	Bank Location
Sycamore	*Platanus racemosa*	full sun (5)	prefers moist	well-drained	UB
Grape	*Vitis girdiana*	sun or partial shade (3)	occasional to regular	well-dry or moist	LB
Mugwort	*Artmesia douglasiana*	sun or shade (1-5)	low	moist to dry	LB,MB
Black berry	*Rubus ursinus*	sun to partial shade (2)	ample water to establish	moist	MB,UB
Mulefat	*Baccharis salicifolia*	sun to partial shade (3-5)	medium	moist	LB

Propagation Method

Plant collection will be done in the pre-dawn hours using sterilized loppers and pruners. Equipment will be sterilized with 91% isopropyl alcohol (CVS brand). Buckets used for soaking the collected plants will be power-washed, dried then sprayed with alcohol and wiped. Buckets will be filled halfway with water to store the cuttings, and the buckets will be kept in the Artichoke Thistle room for three days and the water will be changed daily. Two small *Salix* pieces (2-3 inches long) will be added to the water, which produce auxins and promote rootbud formation (6, 10). When we change the water we also added new *Salix* pieces and remove the old ones.

Collection

Collection time and place: Collection of cuttings to be used in planting will be done when plants are dormant, during the winter months (at the end of January). Specific details on collection and planting for each of the selected species are listed below. Cuttings will be of this year's growth and will be collected in the morning using sterilized cutting equipment. Early morning collection ensures that the plants are fully turgid and limits transmission of pathogens. Cuttings will be kept warm and moist until they are planted (2).

For woody species (*P. racemosa* and *B. salicifolia*): A straight cut will be made at the narrow end of the stake (toward the tip of the branch) and an angled cut will be made at the thicker end (toward the trunk). The upper tip (side that is cut straight) will be dipped in latex paint to help prevent water loss. Be sure to plant the wider, low end of the cutting into the soil. It is important to plant live stakes with the bottom end in the ground; otherwise they will die (2). Additionally, the bottom ends of the stakes will be cut again, *before* soaking them in water to reduce the process of cavitation. These fresh wounds will help to stimulate root growth while the cuttings are soaking. Any leaves, buds or flowers should be removed. The cuttings will be from long, upright branches taken off the parent plant and will be between 18 and 24 inches long. Stakes will be driven into the stream-bank at least one foot deep with a rubber mallet and a planting bar (2).

We collected on 1/31/12 starting at 7:00am. One intern grabbed the truck and supplies we had in the office and the other filled up buckets with about 4 inches of water. We collected all Mugwort shoots and rhizomes first. We recommend bringing two buckets when collecting rhizomes… one to put the plants in initially to remove all the dirt and then a second one to store them in after they've been rinsed off. The mugwort collection site was just south of the large flat creek crossing. After we collected mugwort we came back to store them in the A/T room until after we obtained the rest of the cuttings Then we went out with all of the rest of the buckets and collected the remaining species. We started at the furthest south site near the fourth Bell Creek crossing and collected all blackberry, all grape and some sycamore and mulefat. We worked our way north and stopped at collection spots we had previously scouted out and also collected our first batch of willow pieces. Once we had the rest of our cuttings we went back to the workshop and processed all of them at once. We finished collecting by 11am.

Ethics: Only one twentieth of a plant or plant population will be collected. Populations must be twenty plants or more, or, in the case of a population of only twenty plants, only one plant should be used. Also, remove no more than 5% of each plant.

Tips: In general, cuttings taken from young plants root in higher percentages than cuttings taken from older more mature plants. Cuttings from lateral shoots often root better than cuttings from terminal shoots (1).

Species Specific Information

Platanus racemosa and Baccharis salicifolia

<u>Collection:</u>

Take hardwood cuttings from dormant mature stems. Cuttings should be of the current season's growth. Cuttings should be at least 24 in long so that 1 ft can be above ground and 1 ft below ground. Cuttings will be a minimum of 0.5" in diameter. A good tip for locating these straight, newer-growth shoots for *Platanus* is to look at exposed root systems of trees in the creek corridor. These shoots are

glabrous and light gray to brown to green. Sterilized loppers/pruners will be used to obtain cuttings. Cuts will be made just below a node.

Cutting Preparation:

All leaves will be removed from cuttings. In order to encourage callusing and the formation of roots, each cutting will be wounded by removing two 1-inch slices of the outer tissue layer from opposite sides of the base of the stem using a razor, deep enough to expose the inner tissue, but not so deeply that the stem is cut in half. Cuttings will be stored in sterilized buckets with water for three days prior to planting and the water will be changed daily. Two willow cuttings will be placed in these buckets to promote root growth via auxins. The willows should be changed daily as well. Buckets will be stored in the Artichoke Thistle room.

Planting Technique:

A hammer and rebar will be used to make holes for cuttings. Holes will be 1' deep. Holes will be soaked with water before and after cuttings are placed. Use best judgment on saturation based on soil type, soil moisture, weather, and size of cutting.

Rubus ursinus

Collection:

Cuttings will be from terminal branches of the current season's growth and a minimum of 12 inches to include 6 leaf nodes.

Cutting Preparation:

Leaves will be removed from the lower half of cuttings. Cuttings will be stored in a bucket with water and willow cuttings in the Artichoke Thistle room for three days prior to planting, with the water and willow changed daily.

Note: We disregarded the step of leaving upper leaves on cuttings and removed all leaves.

Planting Technique:

Hammer and thin rebar will be used to make a hole deep enough to include at least 3 nodes in the soil. Holes will be saturated with water before and after planting.

Vitis girdiana

Collection:

Cuttings should be of the current season's growth, and should be long enough to include 6 leaf nodes. Cuttings will be taken from the terminal end of the stem. Clippers will be used to obtain cuttings. When taking the cuttings, cut at an angle to provide a greater surface area for the absorption of water and the formation of roots. Cuts should be made below a node.

Cutting Preparation:

Cuts should be made again just below the node before soaking in buckets. Water and willow should be changed daily. Remove any leaves present on cuttings. Remember to wound (*see Collection*).

Planting Technique:

Use a hammer and rebar to make a hole in which to plant the cuttings. Make the hole deep enough to include at least 3 nodes in the soil Before placing the cutting in the hole, saturate the hole, then again after the cutting is in place.

Artemesia douglasiana NEW INFORMATION

Collection:

Rhizome cuttings should be at least 3 inches (7.6 mm) long with at least 3 nodes per cutting.

Figure 3. Look for parent plants with sprouting shoots at the base. These juvenile shoots are desirable for use in planting and also are connected by rhizomes similar to the one in the figure below.

Figure 4.
Left: Shoot cutting. Right: Rhizome cutting.

This shoot was part of this rhizome before separation. Note the purplish bud nodes on each cutting. These bud nodes are important for tertiary root formation and shoot development.

Shoot cuttings should be at least 0.2 inches (4mm) wide at the base and 4.7 inches (12mm) long. The cut should be at an angle at the bottom and the tops left on. Leaves should be left on top few inches for as long as plants are in water. Shoot cuttings are often found as part of a rhizome. Separate (cut) the shoot from the rhizome/roots. In some cases, it is possible to include a small portion of the root/rhizome that was underground for that individual shoot cutting.

Planting Technique:

Rhizomes: trowels should be used to dig holes about 2-3” deep, 6” wide. Holes should be watered before planting, then placed horizontally in hole, covered with soil and watered after rhizome is covered.

Shoots: a hammer and thin rebar will be used to make a hole to include about half of the plant. *Note: It is important to make sure that shoot cuttings do not exceed 4.7 inches because they do not have the structural capacity to stay upright. However, they *will* wilt after planting and then gradually turn upright as they become turgid with water. Saturate the hole before and after planting.

Planting

Once the plants are ready to be installed, we will clean rebar, trowels, and use a LEST bucket to prevent exotic seed dispersal. We will rake leaves and other brush to clear the ground; annual grasses may have to be removed for the surrounding area of planting, and then leaves and brush will be put back after planting. We will use a rebar less than 1” in diameter for mugwort shoots, blackberry, and grape cuttings (as suggested by previous interns). Each hole will be saturated before and after planting; a planter and a hole-driver (with mallet) will also be required. We will have to be aware that rocks may get into the way. We will determine a protocol

for this situation as it arises (1, 5)……NOTE: This situation did arise for our 2012 plantings. Our site north of the conference room was compacted from heavy machinery use and was littered with rocks. Pete partially filled in this area with loam and gravel from the large flat crossing area and this fill contained many small to large rocks. The combination of compacted soil and numerous rocks in this enhancement site forced us to use pick mattocks to break up the soil and clear rocks from each of our forty plots. We used the help of five OCCC's with pick mattocks the day before planting and then tilled the plots with trencher-cultivators to further break up the soil aggregates and pick out smaller rocks. The pick mattocks helped us to break up compacted soil about six inches below the surface. However, the soil was still substantially compacted a few inches deeper, which made planting the next day interesting.

Planting in this soil was done with Scott and Lauren and started right at 8am. Because the lower layers of soil in each plot were still relatively compacted, we used a combination of buckets and a hose to pre-saturate each plot to make driving the rebar an easier process. If rocks were encountered, the person hammering the rebar can try to drive the rebar through smaller rocks, but it is recommended that the hole be relocated to a different spot within the plot. Although protocol suggests even, symmetrical spacing of cuttings within a plot, sometimes it does not work out that way. Pre-soaking plots seemed to work well, however over soaking them may be a problem if the soil becomes muddy and anoxic- preventing oxygen to infiltrate the soil. Also, in a situation like this, consider the fact that compacted soil may deter deeper root penetration and growth. Possible solutions for this are testing for soil compaction, driving rebar or an auger further into soil to create spacing, altering watering regimes, and planting cuttings along side riparian species that grow though hard pan soils such as mugwort, creeping wild rye, and ragweed (12). Pre-soaking worked well and we were done planting cuttings at 11am.

Irrigation

For the irrigation system, our goal was to be able to soak each plot as uniformly as possible so that all the cuttings in each plot received enough water to grow. Initially, we thought about lining each cutting with its own dripper- a dripper per cutting in every plot. However, we figured that with less drippers (less work for us, less drippers used) we could cover all of the cuttings with the correct amount of water we wanted for each plot. We came up with a four dripper line that was attached to the main 5/8 line, for each plot. The main 5/8 line was fed just above the top two cuttings (top meaning highest in elevation/closer to the road). 2-3 inline drippers and one end dripper were used for each plot. Using one less dripper in each plot posed some problems because certain drippers pooled water away from some cuttings. To fix this problem, we made small trenches and rivets toward/around the cuttings that were not receiving enough water. This method proved successful and we were able to get water to each cutting with four drippers. Additionally, we checked the drippers often for plug-ups because the tap water is hard. If the drippers became plugged we soaked them in vinegar.

Figure 5. Cutting Enhancement site with irrigation.

Figure 6. Plot with irrigation set up- 4 drippers per plot.

Watering Regime

Following past interns' watering regimes, we watered each woody cutting plot with a total of three gallons of water per day. Mugwort and blackberry were watered with 1 ½ gallons per day. The irrigation system was set up using four 1 gal/hour drippers (per plot) for *B. salicifolia, P. racemosa,* and *V. girdiana* and four 1/2 gal/hour drippers (per plot) for *A. douglasiana* and *R. ursinus*. Plots are watered for 15 minutes, three times a day, everyday for the first three weeks and every other day starting week 4. As with past interns, it was more important to soak the whole plot rather than each individual cutting. However, we did dig some small trenches in plots if a certain area was not receiving adequate water. Other factors to consider are: slope position, main line orientation, misters or drippers, etc. During this time, rainfall at Starr Ranch will be monitored and anytime rainfall is expected for multiple days the irrigation will be turned off if soil is saturated or more than 0.5 inches of rain falls each day (1). NOTE FROM SANDY: irrigation schedules and amounts of water will vary with our highly variable rainfall climate. Irrigation will have to be adjusted as per amounts of rainfall in any one season. Additionally amounts of irrigation moisture will vary during a season depending on rainfall.

<u>Data Collection Form & Frequency:</u>

Quantitative: In order to monitor each individual plant, each 1x1m plot was given a letter and number corresponding to the species and location of the plot (A=Mugwort, B=Blackberry, G=Grape, M=Mulefat, S=Sycamore), which can be seen in Figure 1. Figure 2 then shows the numbers for each individual plant within the 1x1m plots, resulting in the naming of plants as such: A1, 5.

Baseline data will be collected for all plant species within each plot, then 8 randomly chosen individual plant cuttings will be chosen for continuous monitoring. If this individual dies, another individual will be chosen again by random. Baseline Data Sheet can be found at: S:\ Sandy\Riparian ISC&R→Riparian Internship→2011-12→Enhancement→Cuttings→Data and datasheets→species list 11-12.xls. (Tab name "Baseline Data Plant Ind").

For monitoring plants, bi-weekly measurements will include the number of leaves and number of buds of each plant, height of each plant (from ground to tallest leaf without stretching) and diameter (taken 5 inches (13 cm) above the ground with a use of a caliper). *R. ursinus, V. girdian,* and *A. douglasiana* diameter does not need to be taken. Mortality data will be taken once a month after baseline data is collected.

Data sheet can be found at : S:\ Sandy\Riparian ISC&R→Riparian Internship→2011-12→Enhancement→Cuttings→Data and datasheets→species list 11-12.xls. (Tab name "Weekly Datasheet").

Data regarding whether or not the plant is green will be taken weekly from all 200 individuals, while numbers of leaves and buds (weekly), and height and diameter (taken 5 inches above the ground) (monthly) will be collected only from the randomly selected plants. *R. ursinus, V. girdiana,* and *A. douglasiana* diameter will not be measured.

Results

Table 2. Shows the survival of 200 cuttings (n = 40 cuttings per species) within the new enhancement site.

Species	Green	Not Green	% Survival	2011 % Survival
P. racemosa	37	3	91.9%	90%
B. salicifolia	40	0	100%	75%
V. girdiana	37	3	91.9%	92.5%
A. douglasiana	37	3	91.9%	15%
R. ursinus	36	4	89%	65%

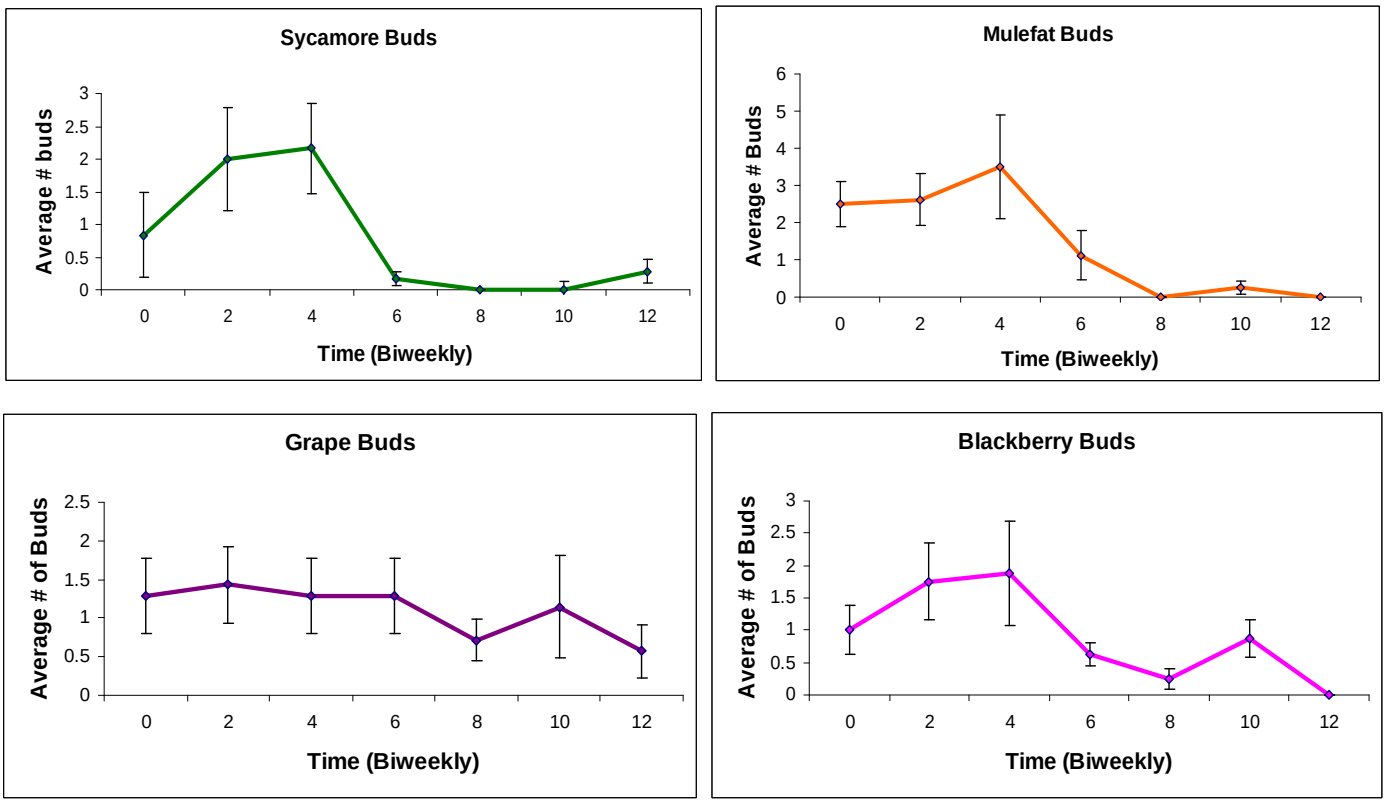

Figure 7. Average number of buds (±SE) of randomly selected individuals over a 12 week period with data taken every two weeks. Data is not given for mugwort because those individuals only had one bud on the top of the stem every week. Results were recorded up until 5/3/12.

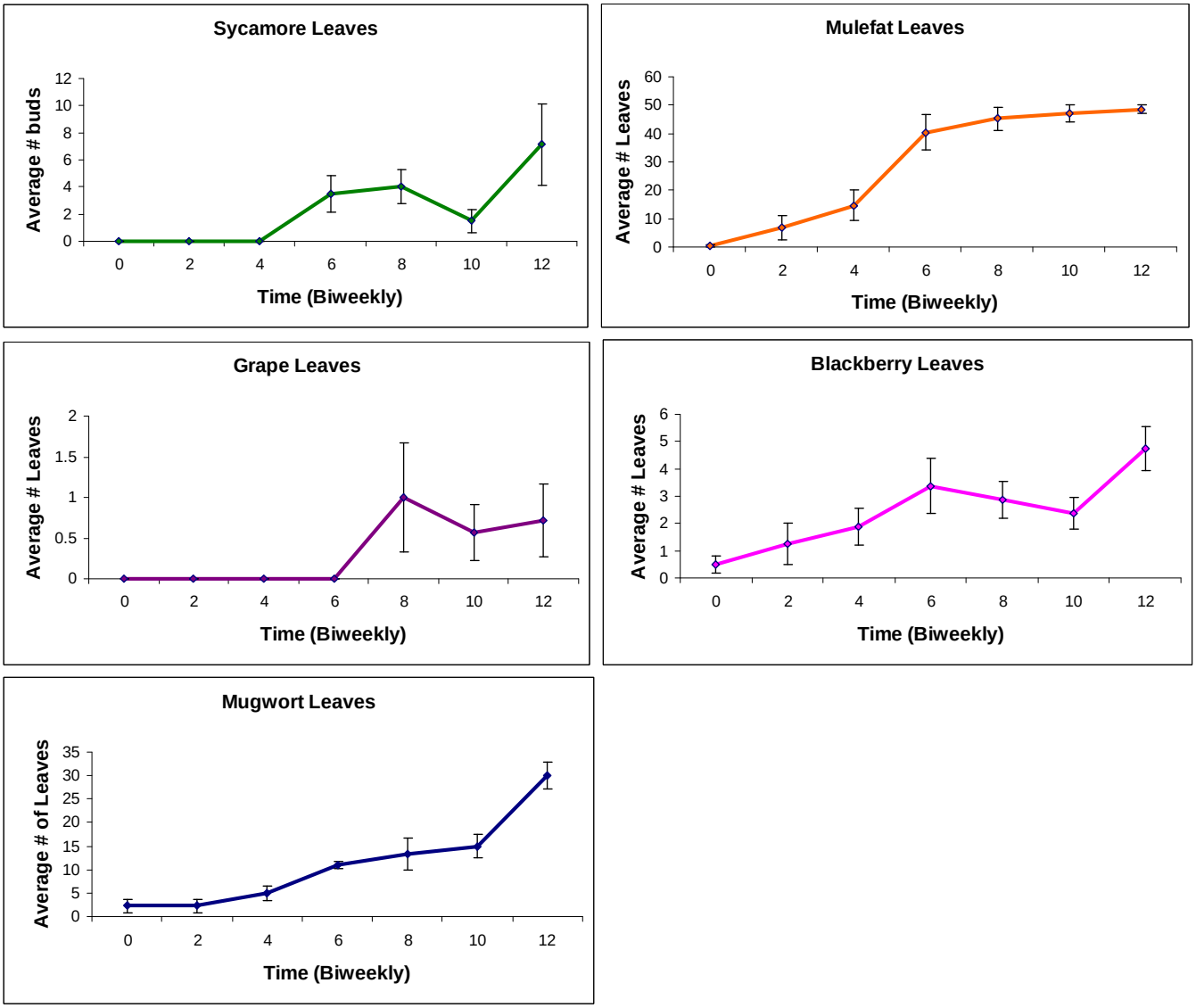

Figure 8. Figure 4. Average number of leaves (±SE) of randomly selected individuals over a 12 week period with data taken every two weeks. Results were recorded up until 5/3/12. Note: The leveling-off behavior exhibited in the above mulefat graph is due to a ceiling leaf cut off of "50+" leaves when the data was recorded. Further details are provided in the discussion section.

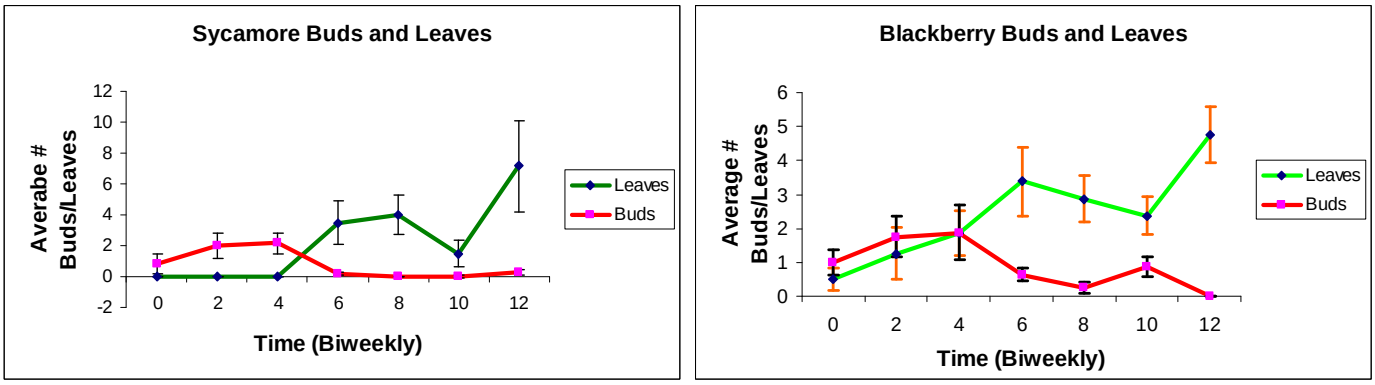

Figure 9. Average number of buds in relation to leaves (±SE) of randomly selected Sycamore and Blackberry individuals.

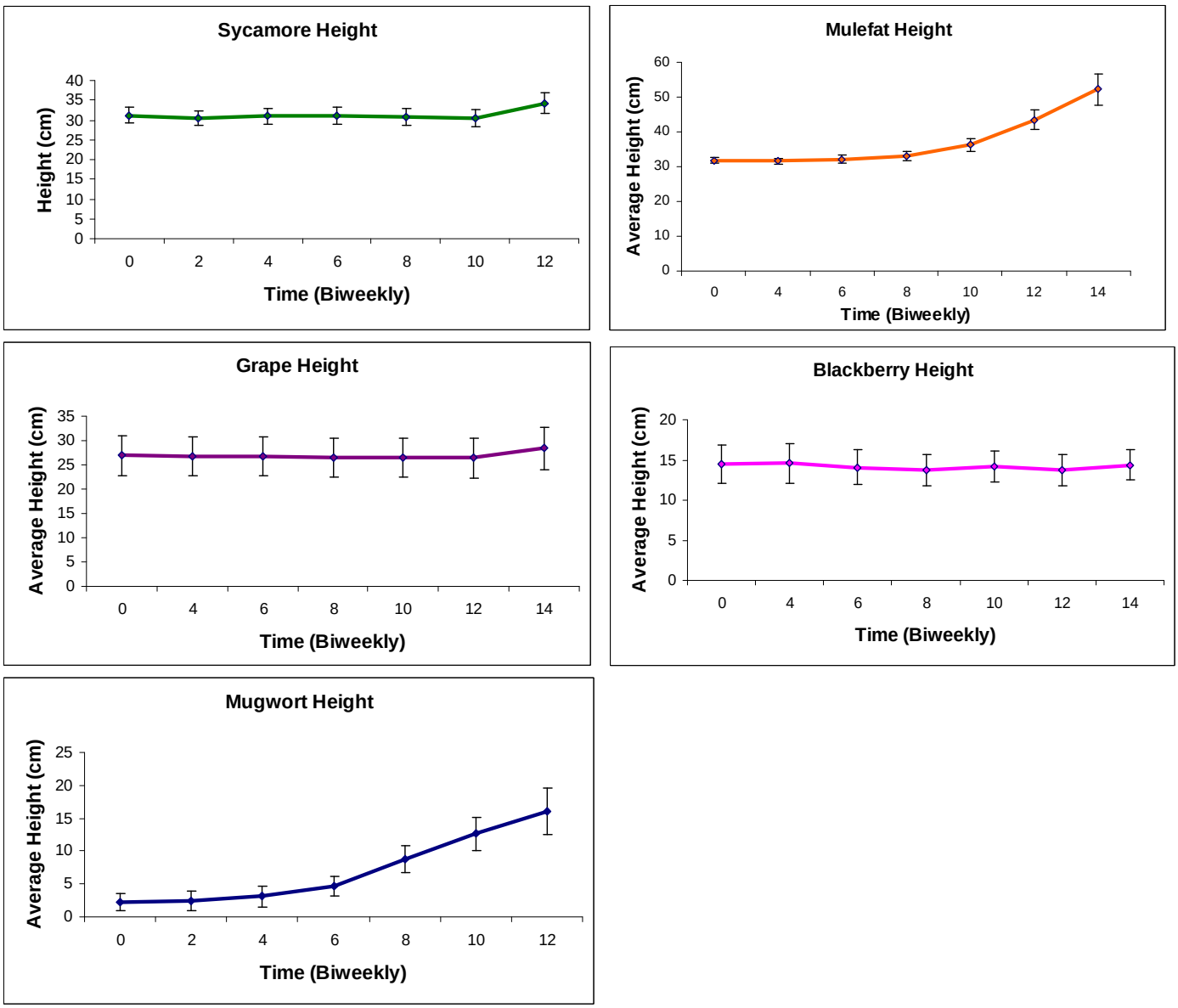

Figure 10. Figure 5. Average height (cm, ±SE) of randomly selected individuals over a 12 week period with data taken every two weeks. Results are as of 5/3/12

Table 3. Survival numbers of mugwort rhizomes and shoots. n = 40 baseline shoot and rhizome cuttings. Data taken May 3, 2012.

A. douglasiana	**2012 # Survived**	**2012 # Dead/Destroyed**	**2011 # Survived**	**2011 # Presumed Dead**
Shoots	17	3	17	3
Rhizomes	20	0	0	20
Total	37	3	17	23

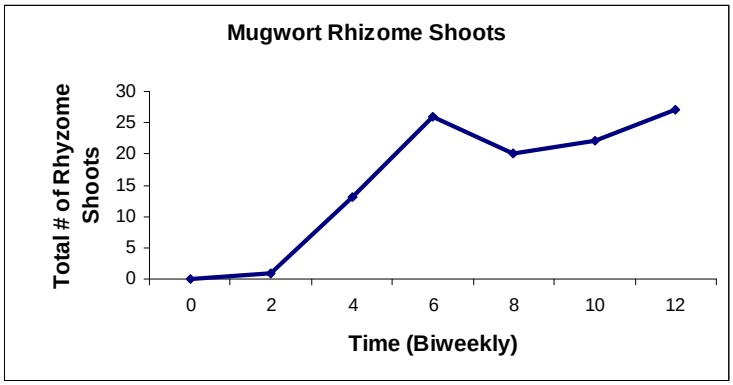

Figure 11. Total number of shoots that grew from the four randomly selected mugwort rhizomes over a 12 week period. Results are as of 5/3/12

Photomonitoring

Figure 12. Randomly selected mugwort rhizome A7,5 on 3/8/12, 4/5/12, and 5/3/12.

Figure 13. Randomly selected mulefat M8,5 on 2/23/12, 4/5/12, and 5/3/12.

Figure 14. Randomly selected blackberry R2,1 on 2/9/12, 3/22/12, and 5/3/12

Figure 15. Randomly selected sycamore S4,5 on 2/9/12, 3/22/12, and 5/3/12

One of our two randomly selected grape cuttings died throughout the monitoring process and the other showed no significant growth, hence they are not pictured here.

Discussion

We planted our cuttings on Thursday February 2, 2012 just a few days before the 2011 plantings took place, which were planted on February 4, 2011. Since we needed to set up irrigation after we planted and re-tweak it over the next week, we started taking monitoring data the Thursday after we planted (2/9/12) and every other Thursday after that. After the first month of taking data (our cuttings were actually *in the ground* for five weeks) we saw that most of the cuttings' numbers of buds peaked. On average- even with the extra week added, our cuttings developed their maximum amount of buds one to two weeks earlier than the 2011 cuttings did. This may have been attributed to the amount of sunlight our cuttings were receiving which was significantly more than cuttings planted in 2011, or possibly by our irrigation system which delivered sufficient water to each cutting rather uniformly.

After the first month, buds were replaced by leaves in most of the cuttings- especially in sycamore, blackberry, and mulefat. Figure 9 shows the more pronounced relationship between bud and leaf development in sycamore and blackberry. As buds grow and develop, they give way to emerging leaves. Buds peak, then decline as leaves begin to grow. On week ten, a rather drastic decline in many sycamore leaves was observed. This was most likely due to the fungus Sycamore Anthracnose (*Apiognomonia veneta*) (13) which affects most sycamores annually. Most trees are able to recover and retain and/or re-grow leaves. Of the cuttings that survived this fungus, some sprouted new buds and leaves, which can be observed between weeks 10 and 12. Grape had the least leaves sprouted in our 2012 plots and, although this is similar to the 2011 grape plot, the 2011 grapes had a steadier and more stable increase in leaf production than our 2012 plots (13).The low number

of leaves may have had something to do with us removing the buds from the grape cuttings before planting. Mugwort had a fairly stable rate of leaf growth and did quite well throughout our site. Aside from one shoot that was improperly selected (collected at more mature stage) and 2 shoots that disappeared and were most likely eaten by pocket gophers, we had very good responses and growth from both shoots and rhizome cuttings. 2012 mugwort survival percentages were significantly higher than that of 2011 with a 91.9% compared to 15%.

Our mulefat cuttings were also very successful, however it is worth noting the leveling-off trend observed in Figure 8 for mulefat leaves. This behavior is evident because, while we were taking monitoring data, we set a cut-off number for leaves at “50+ leaves” although there were many more than 50 leaves on many of the mulefat cuttings. This technique does not prove very descriptive of mulefat leaf development and therefore we do not recommend a “number+” cut off number when taking monitoring data in the future for leaves. Aside from that, 2012 mulefat survival percentages were at 100% by week 12 compared to 75% for 2011 mulefat.

Blackberry showed a partial decline in leaf development by week 10. This may be attributed to increasing spring temperatures and daily solar radiation, as some leaves were observed to be drying and browning. Also, we cut the leaves off of our blackberry cuttings before we planted them this was not what interns did in past years. An interesting point to add was that blackberry cuttings that were located closer to the conference room and tree shade developed leaves more rapidly and also started growing shoots that sprouted from underneath the ground. However, many blackberry cuttings that remained in full to nearly full sun still kept leaves, but had stunted growth, while others expired, showing that blackberry had the lowest survival percentage with 89% survival. However, the blackberry survival percentage remained higher with 89% of individuals surviving as opposed to 65% from 2011.

The only species with height averages to note were mugwort and mulfat. Both of these species grew steadily through the 12-week monitoring period. Other species such as sycamore and grape showed no significant height gain except for week 12 where there were small height gains by both species. Blackberry shows a slight decline in height and this could signify that some terminal shoots and/or leaves that were present early on wilted or died back by the end of the monitoring period.

Lastly, a metric that has not been used before in past intern reports is the total number of shoots grown by mugwort rhizomes as shown in Figure 11. Our sample size was only four cuttings, however we feel it is a representative trend of most of the 20 mugwort rhizomes planted and shows just how successful these cuttings were. Shoots began to develop after two weeks and looked much like that of the first picture in Figure 12. Total number of shoots steadily increased and then declined slightly. This may be due to young, fragile shoots being susceptible to warm, dry weather conditions or being out-competed by other faster growing shoots of the same rhizome. There is a gradual increase after this decline showing that these rhizome cuttings are fairly resilient and capable of producing many shoots compared to shoot cuttings that were stuck standing in the ground. In

terms of growth, these rhizome cuttings grow much more vigorously than the shoot cuttings and are very much worth the time and effort to collect based on our 2012 results. Compared to shoot cuttings they gave us "more bang for our buck" in terms of growth rate and number of shoots grown from out of the ground. These rhizome cuttings also are buried as a root system which may help explain their resilience and potential to withstand environmental fluctuations. We highly recommend using rhizome cuttings for future restoration projects.

Other Recommendations

The 2010-2011 interns recommended to us to choose a slightly larger sample size of randomly selected cuttings to monitor. Unfortunately, we did not discover this recommendation until it was too late, yet we think it is a smart thing to do. We recommend a selected sample size of 10 cuttings per species which are randomly selected and also not replacing selected cuttings which have died with living cuttings for monitoring purposes. We also believe that it may be useful to look into the possible propagation of *Salix sp* (willow species) and *Sambucus mexicana* (blue elderberry) for future riparian restoration projects.

Lastly, we recommend that when considering where and how to place species in a restoration area, weigh *light requirements* as equally important as proximity to water and/or the creek (i.e. zone placement of species).

Further research questions to consider in native species propagation for restoration projects:

- How do light gradients and daily light exposure affect different species?
- How important is placing specific species in recommended "life zones" (i.e. proximity to creek)?
- Does leaf litter and/or mulch support native plant growth and suppress weeds?
- When can irrigation be turned off permanently? Is it species specific?
- Which species can be planted together so as to promote mutually beneficial relationships?

<u>Literature Cited:</u>

1. S:\ Sandy\Riparian ISC&R→Riparian Internship→2010-11→Enhancement→Woody Cuttings→Past protocols→2009-2010→Riparian Enhancement Protocol

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3. S:\ Sandy\Riparian ISC&R→Riparian Internship→2010-11→Enhancement→Woody Cuttings→Past protocols→2008-2009→Riparian Enhancement Final Report.doc.

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5. S:\ Sandy\Riparian ISC&R→Riparian Internship→2010-10→Enhancement→Woody Cuttings→Past protocols→2007-2008→Notes on collection, planting, watering etc.doc

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11. Division of Planning, Ventura County, 2006. Guide to Native and Invasive Streamside Plants: Restoring Riparian Habitats in Ventura & Along the Santa Clara River in Los Angeles County.

12. Margot Griswold, email to Sandy DeSimone- Friday, February 3, 2006

13. S:\ Sandy\Riparian ISC&R→Riparian Internship→2010-11→Enhancement→Riparian Enhancement Final Report

Audubon CALIFORNIA

Starr Ranch Sanctuary

Habitat Restoration

Goal

At Starr Ranch, Audubon California protects and restores the last remaining wild habitats of Orange County. Starr Ranch serves as a regional model for groundbreaking non-chemical methods of restoration enacted by both community volunteers and highly qualified field crews. Our goal is to actively restore 1,600 acres of degraded habitat, representing approximately 40% of Starr Ranch's total acreage, by 2020.

About Starr Ranch

Starr Ranch is a 4,000-acre Audubon Sanctuary in Southern California's highly suburbanized Orange County. All native habitats and wildlife are becoming rare in California, and the Ranch protects some especially endangered vegetation types such as coastal sage scrub, needlegrass grassland, and riparian woodland as well as species such as the federally threatened California Gnatcatcher (a songbird) and orange-throated whiptail (a lizard). The Southern Californian wild landscape has been subjected to development, repeated fire, and now faces the uncertain impacts of climate change. Additionally, invasive plants damage habitats across all of California's native landscapes. After invasive species control, restoration of native habitat is the second essential step towards bringing back the remarkable wild Mediterranean-climate landscapes of Southern California.

Starr Ranch protects some of the last pristine (i.e. undeveloped and unburned since 1980) wild landscapes in Orange County, and the management of these critical habitats begins with abating the threat of invasive species. At Starr Ranch, we take an innovative approach to invasive species control and rare habitat restoration that is both research-based and done completely without the use of toxic herbicides. Our goal is to serve as a model for the southern Californian region of a rigorous, sustainable approach to land management. Starr Ranch's restoration work has received state and national recognition and is praised as "unique and cutting edge" by the U.S. Fish and Wildlife Service. Our restoration work focuses on three rare California native habitats on Starr Ranch: coastal sage scrub, needlegrass grassland and creek-side habitat (known as riparian habitat.) As of 2011, a total of 485 acres are under active management.

Coastal Sage Scrub Project

Coastal sage scrub (CSS) restoration at Starr Ranch began in 2001 using unique methods that were developed onsite by Audubon staff and are now used by other preserves and parks throughout Southern California. Restoration sites follow a documented trajectory of invasive species control, native planting, and establishment with follow-up treatments until they reach a functional state close to a natural system. The field crew that works in the uplands uses physical methods to control targeted invasive plants in project sites. We use experiments to develop and refine restoration techniques. Currently 172 acres of coastal sage scrub are being restored of the 485 total upland invasive control acres the crew covers, and 15-30 acres will be added each year until the ultimate goal of 250 acres is reached.

Needlegrass Grassland Project

In 1999, Starr Ranch initiated a carefully designed, experiment-driven, non-chemical removal of a high priority invasive species, artichoke thistle, in 270 acres of our best needlegrass grasslands out of a total 700 acres of infested sites on the Ranch. After only one year of treatment, thistle

populations are reduced by 95%. Native grassland enhancement will eventually occur in 450 acres of the 700. As of 2011, the Starr Ranch field crew is controlling invasive species and testing methods of enhancing existing native grasses in 298 acres of needlegrass grassland. The last remaining native grasslands are slated for invasive control and enhancement during the 2013-14 season.

Riparian Project

Creek-side habitat – known as a riparian zone – is the vegetation along a stream or river. The Starr Ranch riparian restoration project has been ongoing since 2003. Two seasonal interns mapped invasive plants during the first years of the project and now recruit community volunteers for the Weed Warriors program. In 2007, the Ranch began a cooperative riparian invasive control project with the Orange County Conservation Corps (OCCC), who serve at risk young adults, to remove invasive plants along Bell Creek, a riparian corridor that is almost 5 miles long. As of 2011, interns and Weed Warrior volunteers worked in a total of 4.4 acres of an 11 acre intensive management area that outlines the extent of a high priority invasive species (periwinkle) along the main riparian corridor of Bell Creek. Riparian work acreages are relatively low since only two interns and volunteers do most of the work, using hand tools for safety. We add about 0.5 – 2.0 new invasive control acres per season, and monitor and restore in all work acreage. Interns walk the Bell Canyon riparian corridor (232 acres), each season to map and control rapidly spreading invasive plants. It is our expectation that we will eventually add Crow Canyon to this project, a second major riparian zone representing 129 acres for which we have completed the mapping of invasive plants. Projection for riparian project completion is less certain than in uplands since annual numbers of volunteers and OCCC crew funding are highly variable. Additionally, degraded (i.e. dominated by invasive species) stream banks are much less discrete and measurable than are the upland sites that occur in patchy mosaics. Generally, we hope to have most degraded stream banks with priority invasives under control by 2020.

Summary of Long-term Project Goals

In total, it is our goal to actively restore 1,600 acres, representing approximately 40% of Starr Ranch's total acreage. At our current rate, we can expect to reach this goal by 2020.

Needs

To achieve our restoration goals, Starr Ranch is dependent on the seven young temporary staff, recent college graduates, hired each season. Since the staff lives in historic Ranch buildings, salaries can be kept relatively low, totaling $82,000 per year (CSS restoration in southern California can cost $60,000-120,000 per acre). Annual costs over the next five years will remain stable since older restoration sites require less staff time. With additional support services charges, the current annual budget for restoration, including equipment and supplies, is $145,465. Restoration is an ongoing, long term process. The threat of new invasive species, repeated fire, and climate change require continual and persistent management and monitoring, in an approach advocated by the Ecological Society of America. To maintain rare habitat work at Starr Ranch in such a manner would require $727,325 over the next five years.

Summary of Long-term Project Goals

Riparian – 361 acres *
Needlegrass grassland – 450 acres
Coastal Sage Scrub – 250 acres

Total of 1,601 acres

* Note: these total acreages for riparian based on GIS estimates of creek area. Using a standardized definition of riparian (100 feet from creek center line onto both banks), Bell Creek was estimated at 125 acres and Crow Creek at 84 acres.

Invasive Control, Restoration, Monitoring, and Education at Audubon Starr Ranch Sanctuary

April 2012 Quarterly Report: due April 30, 2012
Project Director: Sandy DeSimone
Watershed: San Juan Creek

Brief Description of Project

The Starr Ranch invasive control and restoration project is completely non-chemical, research-based (i.e. uses adaptive management), and landscape scale (i.e. both riparian and upland). The riparian project is supervised by the Director of Research and Education and staffed by two seasonal interns, recent college graduates who live on site for eight months. Interns recruit and supervise volunteers and, when funding is available, Orange County Conservation Corps (OCCC) crews, to remove priority invasives and also do active and passive restoration in 0.5 – 2.0 new acres per year along the Bell Canyon riparian corridor, which is 4.7 miles long and approximately 232 acres. For the grant period (three years), an OCCC crew will assist with invasive removal at the height of the growing season in spring for one month. Interns also do biweekly walks to cover the entire riparian corridor to map and remove targeted invasive species.

Interns write work plans, protocols, and final reports. Quantitative and qualitative (i.e. photopoints) monitoring results will indicate success of invasive control and passive and active restoration. To assess performance, we will analyze data to detect trends of native vs. invasive cover as well as native woody plant density in both active and passive restoration sites. Restoration success in semiarid regions is dependent on the highly variable timing and amount of annual precipitation (Bakker et al. 2003) so that we feel it is unrealistic to set quantitative performance standards. Instead we will measure performance as trends in total native cover and woody native plant density, with an increasing trend indicative of success. If no increasing native trends are observed after three seasons, we will take measures to reverse trends by intensifying invasive plant control and/or increasing active restoration acreage Though we would expect a trend of increasing native cover after 3 – 5 years, researchers recommend that, because of the high costs and potential for failure of active riparian restoration in the western U.S., land managers monitor the natural recovery process for an appropriate period of time (e.g., 10 years) before implementation of active restoration projects (Kauffman et. al.1997).

Since 2003, Starr Ranch biologists have trained volunteers from local communities to assist with stream bioassessment using aquatic invertebrates. Sampling will be supervised by the Assistant Director of Research and Education and will take place in pristine reaches of Bell Creek to compare with samples in stretches impacted by urban runoff from the adjacent golf course community. Since pumps were installed in 2007 to divert runoff for reclamation by Santa Margarita and Trabuco Water Districts, we expect an improvement in water quality in the formerly impacted stretches. We will continue to survey every year in May or June and will expect an increase in IBI (Index of Biological Integrity) scores in the impacted stretches over time. Additionally, in spring 2011 staff will initiate long term surveys of aquatic vertebrates in Bell Creek as well an annual survey of perennial pools.

The Starr Ranch upland project removes invasives and restores two rare habitats, coastal sage scrub (CSS) and native grassland. A seasonal field crew of five recent college graduates, who also live on site, add 20 - 30 new upland acres per year and use experimentally-derived methods to control artichoke thistle the first year of work. As of 2011 the crew is working in about 500 acres of the 700 total acres targeted for eventual inclusion in the upland project. After the first year of artichoke thistle treatment, the crew also controls other invasives and begins rare habitat restoration. Long term monitoring has shown that crews reduce artichoke thistle cover by 95% per site after one year of treatment. Additionally active CSS restoration sites reach a mean of 60% or more total native cover after 1 – 4 years of restoration. If, after two seasons, there is low native germination, we switch to passive monitoring and have had some success, indicated by trends of increasing total native cover over time (DeSimone 2011).

Staff research on wildlife, habitats, and restoration is integrated into education programs for kids and adults, which is further described in the “end products” section below.

This landscape scale invasive control and restoration project as well as the unique Starr Ranch education programs were created and are now directed by Dr. Sandy DeSimone (Director of Research and Education), who was the recipient of the 2010 California Invasive Plant Council's Land Manager of the Year award.

Task Progress

Weed Warrior Volunteers

Riparian interns Jenni and Mark started their internship in mid October 2011 and immediately began working on their complex set of job responsibilities. From November 2011 through March 2012, they have recruited 193 Weed Warrior volunteers, both kids and adults, who worked a total of 457 hours on riparian invasive removal during 2-3 Saturdays per month. They have four remaining Weed Warrior days in April and June. Our current top three riparian invasives for removal are periwinkle (*Vinca major*), English ivy (*Hedera helix)*, and smilo grass (*Piptatherum milaceum)*. Volunteers usually work on *V. major* with hand tools (weeder/diggers).

Fig.1. On Saturday 3/31/12, volunteers start work in a periwinkle (*Vinca major*) patch.

Fig.2. Nice work, Weed Warriors!

Riparian Invasive Control

In their invasive control work plan, the interns' goal was to add 0.5 new acres to the current 4.25 acre (0.67 mile) invasive control work area along the 4.72 mile long Bell Creek riparian corridor within Starr Ranch. They planned to spend 3 days on maintenance in the "old" work area, 0.5 days on invasive removal in the new area, and 0.5 days on the Bell Canyon roadsides. The target species for nonchemical control are the three previously mentioned invasives prioritized for removal from 2003-04 and 2006-07 mapping. Besides the week-end Weed Warriors, the interns have weekly help from two regular volunteers and occasionally the Orange County Conservation Corps crew. The interns are on track to reach their goal of extending the invasive control work area to 4.75 acres.

Riparian Enhancement

Soon after their arrival in October 2011, the interns wrote a protocol for riparian enhancement and began to collect seeds of two riparian herbaceous species (mugwort, *Artemisia douglasiana* and phacelia, *Phacelia ramosissima*) for seeding in December 2011 and then again in January 2012. They tested two different seed rates and seeding each species alone and in combination. Interns collect monitoring data on survival and growth parameters and also photomonitor every two weeks.

Fig. 3. Interns Jenni and Mark plant mugwort and phacelia in December 2011.

Fig. 4. Irrigation line and young phacelia seedlings in early March, 2012.

At the end of January 2012, Jenni and Mark wrote a protocol for planting native riparian cuttings using methods developed by past Starr Ranch interns. They collected 200 cuttings, 40 each of five native riparian trees and shrubs for planting in approximately 0.10 acres of disturbed streambank adjacent to recently installed gabions: sycamore (*Platanus racemosa)*, mule fat (*Baccharis salicifolia)*, grape (*Vitis girdiana)*, California blackberry (*Rubus ursinus)*, and mugwort (*Artemisia douglasiana)*. After three days of soaking cuttings with willow branches to stimulate root growth. Starr Ranch staff helped the interns plant cuttings and set up irrigation. Interns are currently taking data on growth and survival parameters as well as photomonitoring. All species had leafed out by early April.

Fig. 5. Planting cuttings in early February 2012.

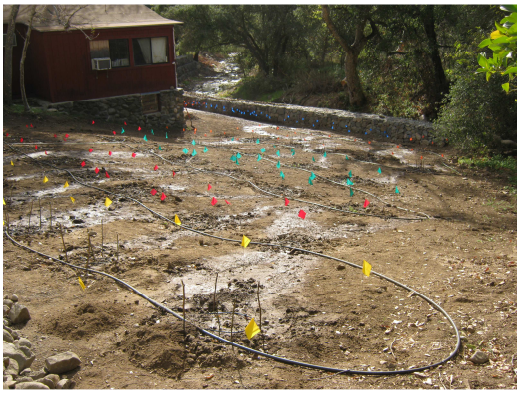


Fig. 6. Irrigation set up.

Fig. 7. Mugwort growing from a rhizome cutting.

Fig. 8. Sycamore leafing out.

Bell Canyon Target Species Mapping

This was the first year for target species mapping of perennial invasives in the Bell Canyon riparian corridor that will require intensive removal methods in current and future years: olive (*Olea europaea)*, palm (*Washingtonia robusta)*, giant reed (*Arundo donax)* (not yet found on Starr Ranch), and pampas grass (*Cortaderia* spp). Jenni and Mark developed a work plan for walking the 4.71 mile length of Bell Creek in Starr Ranch and GPSing the target species for mapping. They had covered 3.4 miles by March 31 2012 (Fig. 9). The Orange County Conservation Corps crew has begun olive removal at the north end of Bell Creek and is slowly moving southward.

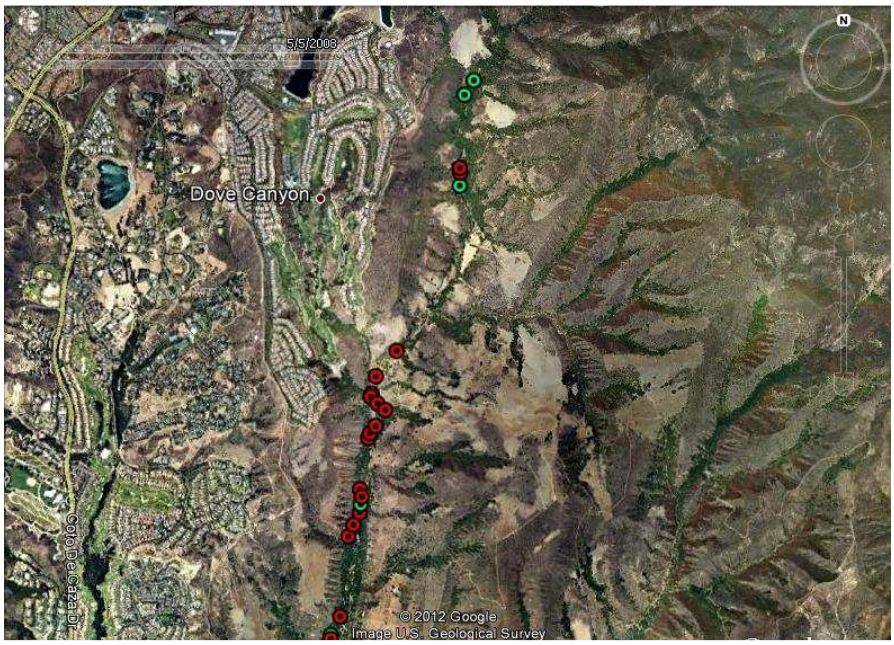


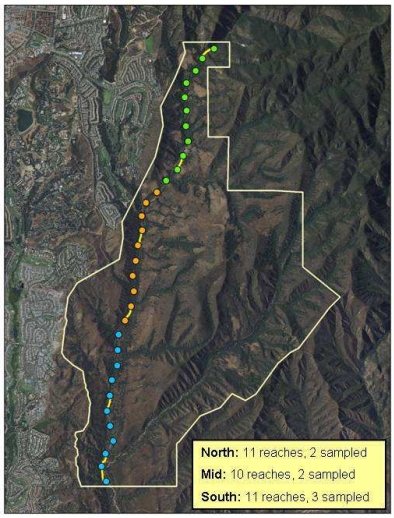
Fig. 9. Preliminary map of the distribution of *Olea europaea* (green dots) and *Washingtonia robusta (*red dots) mapped as of 3/31/12 in Bell Creek.

Aquatic Vertebrate and Perennial Pool Sampling

This was the first year of aquatic vertebrate monitoring in Bell Canyon using the USGS Aquatic Species and Habitat Assessment Protocol for South Coast Ecoregion Rivers, Streams, and Creeks. From June 6 through June 20, 2011, we randomly sampled seven of the thirty two 250 m long reaches within our borders for fish and aquatic amphibians and reptiles (3 reaches in the southern third and 2 reaches in the middle and northern thirds – Fig. 10). Two species of fish, arroyo chub (*Gila orcuttii*) and threespine stickleback (*Gasterosteus aculeatus*), were detected in all regions (north, mid, and south) of the sanctuary. We also found adults, larvae, or egg masses of four species of amphibians: California newt (*Taricha torosa*), California treefrog (*Pseudacris cadaverina*), Pacific treefrog (*Pseudacris regilla*), and western toad (*Anaxyrus boreas*). Generally speaking, both species of treefrogs were ubiquitous and found in all regions and reaches sampled, while western toads were typically found only in reaches with shallow, still, water under open canopy. California newts only occurred in one reach at the northern extent of the sanctuary that contained deeper water and pools.

We also conducted surveys for perennial sources of water in Bell Canyon by walking the length of Bell Creek within our borders from October 1 through November 14, 2011 and recording the presence of all flowing and standing water. This period coincided with the usual dry period of Bell Canyon and all water encountered was therefore considered to be permanent. Most of the water detected was found in the region just south of the confluence of Bell Canyon with Tick and Dove Canyons which receive urban

runoff during the rainy season from the adjacent Dove Canyon housing development. Outside of this zone, which is likely heavily impacted by fluctuating runoff, we only detected one area containing permanent water in the southern region, and two fairly discrete areas of flowing water in the northern region. Continued surveying in subsequent years should help us further define areas of permanent water that may act as refugia for aquatic vertebrates in Bell Canyon.



	North	Mid	South
Amphibians			
Pacific Treefrog	x	x	x
California Treefrog	x	x	x
Western Toad	x		x
California Newt	x		
Fish			
Arroyo Chub	x	x	x
Three-spined stickleback	x	x	x

*non-native crayfish detected in two of three south reaches

Fig. 10. Preliminary results from the first aquatic vertebrate sampling in June 2011.

Orange County Conservation Corps

A 6-10 person crew from the Orange County Conservation Corp (OCCC) started work at Starr Ranch in November 2011. They initiated olive removal in a large population near the Ranch's historic olive grove (Fig. 11, 12). An estimated 25 trees have been chain sawed, suckers removed, and branches chipped during the one month SEP-funded period. A plan for stump removal or tarping is now in planning stages. The research director is currently synthesizing olive and palm removal suggestions solicited through the CalWeedTalk listserv of the California Invasive Plant Council. We are exploring funding sources to continue invasive tree removal in partnership with the OCCC.

Fig. 11. The OCCC crew begins chain saw work in the olive "forest" near the historic Ranch olive grove. .

Fig.12. The OCCC crew chips olive branches for removal to the brush pile. .

Upland Invasive Species Control and Rare Habitat Restoration

The five person seasonal upland field crew of recent college graduates who come to live and work at Starr Ranch for 6-10 months added three new artichoke thistle (*Cynara cardunculus)* control sites (18.6 total acres) for the 2011-12 season. They visit these sites every three weeks and use brush cutters to cut back all photosynthetic surfaces (a method developed over three experiments in 1997-98 – we switch to hoes year two on). Before treatment began in fall 2011, the crew took baseline data in the three sites and will take end of season data in May 2012. In October and again in January, the crew direct seeded natives in three active coastal sage scrub restoration sites (15.6 acres) and took baseline data in two new passive monitoring sites (10 acres). As of April 6, 2012 the Ranch received a total of only 7.25" cumulative precipitation; however, seedlings have survived in all three active restoration sites. Baseline data, taken in fall 2011 in restoration sites, will be compared to end of season (May 2012) data.

Project Director Public Talks

Dr. DeSimone gave an invited talk at the January California Native Plant Society annual meeting in San Diego during the symposium on *Using Science to Increase the Success of Restoration Efforts in California.* She was also invited to speak on Starr Ranch applied research and restoration at the OC EcoMonitoring Workshop at UC, Irvine in January 2012. A UC, Riverside restoration class and biologists from the Ventura County Planning Division visited the Starr Ranch restoration projects in February 2012. Dr. DeSimone is a California Invasive Plant Council Wildland Weed Workshop instructor and gave talks and demonstrations at workshops in Los Angeles (October) and San Diego (January) Counties.
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United States Department of the Interior
U.S. GEOLOGICAL SURVEY
PATUXENT WILDLIFE RESEARCH CENTER
BIRD BANDING LABORATORY
12100 BEECH FOREST ROAD STE-4037
LAUREL, MD 20708-4037
301-497-5790

FEDERAL BIRD BANDING PERMIT

Permittee: Station	Permit Number:	Action:	Action Date:	Issue Date:	Valid Until:
STARR RANCH AUDUBON SANCTUARY MR PETER DESIMONE 100 BELL CANYON ROAD TRABUCO CANYON, CA 92679 3511	20430	Renew	08/17/10	02/05/74	09/30/13
	Signature of Issuing Official, Chief, Bird Banding Laboratory Bruce Peterjohn				
	Signature of Permittee				

Permittee agrees to band in accordance with the general conditions of this permit and with the specific authorization/s listed below:

Permittee is Authorized To Band:

All Species Except Waterfowl, Eagles or Endangered/Threatened Species Unless Specified

In the States of:

CA *

With Special Authorization to:

Trap
Use mist nets
Band
Take feather samples

And Additionally Authorized to Use The Following Auxiliary Marking Authorization/s:

Marker Type	Species	Colors	Locations	Comments
01A Plastic Colored Leg Band	WESTERN SCRUB JAY	Mauve, Orange, Black, White, Green, Yellow, Red	Orange, CA	
01A Plastic Colored Leg Band	PHAINOPEPLA	Red, Yellow, Blue, Green, White, Black, Orange, Mauve	Ventura, CA Los Angeles, CA Riverside, CA San Bernardino, CA	IN COOPERATION WITH KOENIG (21508)
08E Multiple areas Dye/Paint	PHAINOPEPLA	Miscellaneous	Orange, CA	IN COOPERATION WITH KOENIG 21508

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Permittee agrees to band in accordance with the general conditions of this permit and with the specific authorization/s listed below:

The following Subpermittee/s are authorized to band under the direction of the above permittee, in accordance with the same general conditions, and the subpermittee specific authorizations listed below:
(Number of Active Sub Permittees 5)

20430 - C ELPERS M J MRS 3920 KENTWOOD CT RENO, NV 89503

Is Authorized To Band:

All Species Except Waterfowl, Eagles or Endangered/Threatened Species Unless Specified

In the States Of:

CA *

With Special Authorization to:

Trap
Use mist nets
Band
Auxiliary mark

20430 - D KAMADA D K MR 3413 CALLE LA VETA 4855 SAN CLEMENTE, CA 92672

Is Authorized To Band:

All Species Except Waterfowl, Eagles or Endangered/Threatened Species Unless Specified

In the States Of:

CA *

With Special Authorization to:

Trap
Use mist nets
Band
Auxiliary mark
Take feather samples

20430 - F HALL G MS AUDUBON CALIFORNIA STARR RANCH 100 BELL CANYON ROAD TRABUCO CANYON, CA 92679

Is Authorized To Band:

M.A.P.S.

In the States Of:

CA *

With Special Authorization to:

Trap
Use mist nets
Band

Permittee: Station	Permit Number:	Action:	Action Date:	Issue Date:	Valid Until:
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	Signature of Issuing Official, Chief, Bird Banding Laboratory	Bruce Peterjohn			
	Signature of Permittee				

Permittee agrees to band in accordance with the general conditions of this permit and with the specific authorization/s listed below:

20430 - G MS REBECCA L STEWART STARR RANCH SANCTUARY 100 BELL CANYON ROAD TRABUCO CANYON, CA 92679 3511

Is Authorized To Band:

All Species Except Waterfowl, Eagles or Endangered/Threatened Species Unless Specified

In the States Of:

CA *

With Special Authorization to:

Trap
Use mist nets
Band
Auxiliary mark
Take feather samples

20430 - H MR JUSTIN J SHEW 104 BELL CANYON ROAD TRABUCO CANYON, CA 92679

Is Authorized To Band:

Passerines and Near-passerines

In the States Of:

CA *

With Special Authorization to:

Trap
Use mist nets
Band
Take feather samples

FEDERAL BIRD BANDING PERMIT

Under the provisions of Regulations issued under the Migratory Bird Treaty Act of July 3, 1918 (40 Stat. 755) as amended, or the Bald Eagle Act of June 8, 1940 (54 Stat. 250) as amended, the person named hereon is authorized to capture, for scientific banding or marking purposes, those migratory birds described hereon and to salvage birds accidentally killed during normal banding activities.
This permit is subject to the terms, exceptions and restrictions expressed herein and is further subject to any applicable Territorial, State, Tribal or Federal Regulations.
This permit is invalid unless accompanied by any required State permits or licenses.

GENERAL CONDITIONS

1. The Permittee is not authorized to capture or possess migratory birds for any reason other than banding, marking or salvage of banding mortalities for scientific purposes. NOR IS THE PERMITTEE ALLOWED TO HOLD MIGRATORY BIRDS FOR A PERIOD OF MORE THAN 24 HOURS except that the Permittee may possess, for the purpose of donating to a public, scientific or educational institution, birds which die as a result of normal banding activities. Live birds shall be released as soon as practical after capture.
2. The Permittee shall keep RECORDS accounting for the use of all bands received. Periodic RECORDS COVERING THE USE OF THESE BANDS shall be submitted to the Bird Banding Laboratory in accordance with the instructions received there from. Failure to provide data in accordance with the instructions received from the Bird Banding Laboratory is sufficient justification for the revocation of this permit. The Permittee shall keep records of disposition of salvaged banding mortalities for a period of five years and shall be reported to the Bird Banding Laboratory upon request.
3. The holder of this permit shall not sell, exchange, or transfer bands to unauthorized banders or to the general public. All transfers to authorized banders must be communicated to the Bird Banding Laboratory prior to the transfer of bands. Any unused bands remaining when this permit is voluntarily returned, revoked, or expired must be returned to the Bird Banding Laboratory.
4. The Permittee shall, at all reasonable hours, allow any authorized representative of the U. S. Geological Survey or the U.S. Fish and Wildlife Service to ENTER and INSPECT the premises where operations authorized by this permit are being conducted and shall allow such representative to inspect the records relating to such operations.
5. This permit may be SUSPENDED or REVOKED by the Director of the U.S. Geological Survey or authorized representative, if the Permittee violates any of the provisions in the regulations under which this permit is issued or if the Permittee fails to render promptly any reports required. This permit is, at all times, subject to suspension or revocation at the discretion of the Director or representative.
6. This permit is not transferable and must be in possession of the Permittee when exercising the authorizations granted herein.
7. All traps, nets or other capture devices shall bear a TAG or LABEL showing the name, address and permit number of the Permittee; alternatively the trapping area shall be adequately marked with POSTERS provided by the Bird Banding Laboratory. The Permittee's name, address and permit number shall be legibly displayed on such posters.
8. This permit DOES NOT authorize the capture of any birds on any property, public or private without the CONSENT OF THE OWNER OR CUSTODIAN THEREOF.
9. All Banding under this permit is in accordance with the principles, spirit, and intent of the Animal Welfare Act of 1970 and the most recent revision of The Ornithological Council's Guidelines in the Use of Wild Birds in Research.
10. Unless specifically noted on the reverse, the following ARE NOT AUTHORIZED:

a. The taking of blood or feather sampling from any bird.

b. The use of ANY BAND, clip, paint, dye, signal-sending device or any marking device other than the official numbered leg bands issued by the Bird Banding Laboratory.

c. The use of MIST NETS or other nets for the capturing of birds.

d. The use of TRANQUILIZING DRUGS OR OTHER CHEMICALS for the purpose of capturing birds.

e. Trapping or disturbing the nests or nestlings, for the purpose of banding or marking, of species designated by the Secretary of Interior as "ENDANGERED "or "THREATENED."

f. The handling of any PREVIOUSLY BANDED BIRD in any manner which may bias data on file in the Bird Banding Laboratory which pertain to that bird or which may alter that bird's survival potential, behavior or other normal characteristics. This specifically includes adding markers to or removing markers from previously banded birds.

Form 9-475
(July 2007)

Invasive Control, Restoration, Monitoring, and Education at Audubon Starr Ranch Sanctuary

July 2012 Quarterly Report: due July 31, 2012
Project Director: Sandy DeSimone
Watershed: San Juan Creek

Brief Description of Project

The Starr Ranch invasive control and restoration project is completely non-chemical, research-based (i.e. uses adaptive management), and landscape scale (i.e. both riparian and upland). The riparian project is supervised by the Director of Research and Education and staffed by two seasonal interns, recent college graduates who live on site for eight months. Interns recruit and supervise volunteers and, when funding is available, Orange County Conservation Corps (OCCC) crews, to remove priority invasives and also do active and passive restoration in 0.5 – 2.0 new acres per year along the Bell Canyon riparian corridor, which is 4.7 miles long and approximately 232 acres. For the grant period (three years), an OCCC crew will assist with invasive removal at the height of the growing season in spring for one month. Interns also do biweekly walks to cover the entire riparian corridor to map and remove targeted invasive species.

Interns write work plans, protocols, and final reports. Quantitative and qualitative (i.e. photopoints) monitoring results will indicate success of invasive control and passive and active restoration. To assess performance, we will analyze data to detect trends of native vs. invasive cover as well as native woody plant density in both active and passive restoration sites. Restoration success in semiarid regions is dependent on the highly variable timing and amount of annual precipitation (Bakker et al. 2003) so that we feel it is unrealistic to set quantitative performance standards. Instead we will measure performance as trends in total native cover and woody native plant density, with an increasing trend indicative of success. If no increasing native trends are observed after three seasons, we will take measures to reverse trends by intensifying invasive plant control and/or increasing active restoration acreage Though we would expect a trend of increasing native cover after 3 – 5 years, researchers recommend that, because of the high costs and potential for failure of active riparian restoration in the western U.S., land managers monitor the natural recovery process for an appropriate period of time (e.g., 10 years) before implementation of active restoration projects (Kauffman et. al.1997).

Since 2003, Starr Ranch biologists have trained volunteers from local communities to assist with stream bioassessment using aquatic invertebrates. Sampling will be supervised by the Assistant Director of Research and Education and will take place in pristine reaches of Bell Creek to compare with samples in stretches impacted by urban runoff from the adjacent golf course community. Since pumps were installed in 2007 to divert runoff for reclamation by Santa Margarita and Trabuco Water Districts, we expect an improvement in water quality in the formerly impacted stretches. We will continue to survey every year in May or June and will expect an increase in IBI (Index of Biological Integrity) scores in the impacted stretches over time. Additionally, in spring 2011 staff will initiate long term surveys of aquatic vertebrates in Bell Creek as well an annual survey of perennial pools.

The Starr Ranch upland project removes invasives and restores two rare habitats, coastal sage scrub (CSS) and native grassland. A seasonal field crew of five recent college graduates, who also live on site, add 20 - 30 new upland acres per year and use experimentally-derived methods to control artichoke thistle the first year of work. As of 2011 the crew is working in about 500 acres of the 700 total acres targeted for eventual inclusion in the upland project. After the first year of artichoke thistle treatment, the crew also controls other invasives and begins rare habitat restoration. Long term monitoring has shown that crews reduce artichoke thistle cover by 95% per site after one year of treatment. Additionally active CSS restoration sites reach a mean of 60% or more total native cover after 1 – 4 years of restoration. If, after two seasons, there is low native germination, we switch to passive monitoring and have had some success, indicated by trends of increasing total native cover over time (DeSimone 2011).

Staff research on wildlife, habitats, and restoration is integrated into education programs for kids and adults, which is further described in the “end products” section below.

This landscape scale invasive control and restoration project as well as the unique Starr Ranch education programs were created and are now directed by Dr. Sandy DeSimone (Director of Research and Education), who was the recipient of the 2010 California Invasive Plant Council's Land Manager of the Year award.

Task Progress

Weed Warrior Volunteers

Interns Jenni and Mark wrote final reports and gave their final presentation at the end of May 2012. From April through end of May 2012, they recruited 63 more Weed Warrior volunteers, both kids and adults, for a total of 256 volunteers for 2011-12 who worked a total of 650 hours on riparian invasive removal during 2-3 Saturdays per month. Interns recruited from OneOC and VolunteerMatch online but had their biggest numbers from Irvine Youth Action Team, an after school program for middle school kids. Our current top three riparian invasives for removal are periwinkle (*Vinca major*), English ivy (*Hedera helix)*, and smilo grass (*Piptatherum milaceum)*. Volunteers usually work on *V. major* with hand tools (weeder/diggers).

Riparian Invasive Control

In their invasive control work plan, the interns' goal was to add 0.5 new acres to the current 4.25 acre (0.67 mile) invasive control work area along the 4.72 mile long Bell Creek riparian corridor within Starr Ranch. They planned to spend 1.5 days on maintenance in the "old" work area, 0.5 days on invasive removal in their new area, and 0.5 days on the Bell Canyon roadsides. After initial meetings with interns to make sure they understood goals, they then worked independently on their projects. Unfortunately I didn't detect that they had misunderstood the work plan and in the end added only about 0.1 new acres. We discussed the problem and discovered that they had spent most of their time working on maintaining older work areas and on roadside invasive control. Next year interns will use GPS to mark out their new acreage goal so they clearly see where they're heading.

Riparian Enhancement

Interns summarized their data on herbaceous seeding to find that the high seeding rate for the two target species seeded together (*A. douglasiana* and *P. ramosissima*) resulted in the highest mean cover (about 40%) in their 0.25 square meter plots.

Fig. 1. Seedlings of mugwort and phacelia in April 2012 that were planted by interns in January 2012

Fig. 2. By mid July 2012 the January seeding resulted in high cover of mugwort (shown here). The phacelia seedings were less successful.

Survival rates for end of May 2012 for the 200 native woody cuttings planted end of January by interns, 40 each of five native riparian trees and shrubs ranged from 89% (*Rubus urcinus*) to 100% (*Baccharis salicifolia)*.

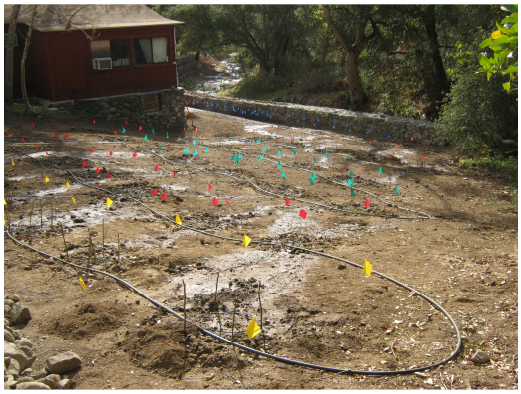

Fig. 3. Irrigation set up, February 2012.

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Bell Canyon Target Species Mapping

Interns Jenni and Mark completed walking the 4.71 mile length of Bell Creek and removed a lot of tree tobacco that had sprouted since 2010-11 flooding and also several tamarisk, mulberry saplings, bull thistle, and one Himalayan blackberry. They completed mapping olive (*Olea europaea)*, palm (*Washingtonia robusta)*, giant reed (*Arundo donax)* (not yet found on Starr Ranch), and pampas grass (*Cortaderia* spp).

Aquatic Vertebrate and Perennial Pool Sampling

From June 6 - June 17 we sampled two, 250 m long reaches, in each of the three regions of Bell Creek (south, middle, north). Dryer than normal conditions this previous winter resulted in low flow conditions at the time of sampling, and flow was greatly reduced from the same sample period in 2011. Despite these low water levels, anuran larvae, metamorphs, and adults were still present, and California treefrogs (*Pseudacris cadaverina*) and Pacific treefrogs (*Pseudacris regilla*) were detected in all three regions of the creek. Additionally, California newt (*Taricha torosa*) adults were once again found in the north region, while two species of fish (arroyo chub (*Gila orcuttii*) and threespine stickleback (*Gasterosteus aculeatus*)), were detected in the middle and south regions.

Lower than average rainfall this year will likely make the upcoming 2012 perennial pool survey in late summer/early fall especially effective for identifying sources of water that persist year-round in Bell Canyon.

Stream Bioassessment

We completed our annual Bioassessment to assess the effect of urban runoff on Bell Creek during May 23 - 24. Benthic macroinvertebrate samples from both sample sites in Bell Creek were sent out for professional identification in mid-June and results should be returned to us by early 2013.

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Upland Invasive Species Control and Rare Habitat Restoration

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In April, the project director spoke on Starr Ranch restoration and education projects at a meeting of the Orange County chapter of the CA Native Plant Society. Staff from the 20,000 acre Rancho Mission Viejo Land Trust visited Starr Ranch to learn about our restoration projects in July.

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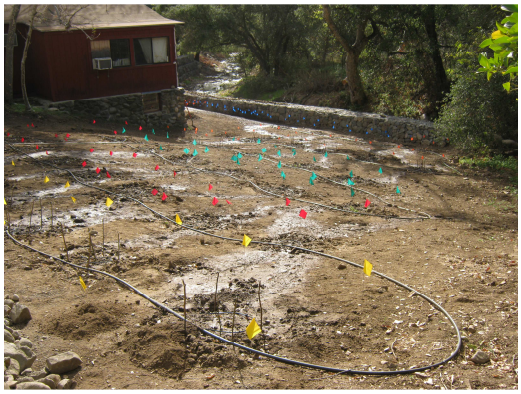

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Since 2003, Starr Ranch biologists have trained volunteers from local communities to assist with stream bioassessment using aquatic invertebrates. Sampling will be supervised by the Assistant Director of Research and Education and will take place in pristine reaches of Bell Creek to compare with samples in stretches impacted by urban runoff from the adjacent golf course community. Since pumps were installed in 2007 to divert runoff for reclamation by Santa Margarita and Trabuco Water Districts, we expect an improvement in water quality in the formerly impacted stretches. We will continue to survey every year in May or June and will expect an increase in IBI (Index of Biological Integrity) scores in the impacted stretches over time. Additionally, in spring 2011 staff will initiate long term surveys of aquatic vertebrates in Bell Creek as well an annual survey of perennial pools.

The Starr Ranch upland project removes invasives and restores two rare habitats, coastal sage scrub (CSS) and native grassland. A seasonal field crew of five recent college graduates, who also live on site, add 20 - 30 new upland acres per year and use experimentally-derived methods to control artichoke thistle the first year of work. As of 2011 the crew is working in about 500 acres of the 700 total acres targeted for eventual inclusion in the upland project. After the first year of artichoke thistle treatment, the crew also controls other invasives and begins rare habitat restoration. Long term monitoring has shown that crews reduce artichoke thistle cover by 95% per site after one year of treatment. Additionally active CSS restoration sites reach a mean of 60% or more total native cover after 1 – 4 years of restoration. If, after two seasons, there is low native germination, we switch to passive monitoring and have had some success, indicated by trends of increasing total native cover over time (DeSimone 2011).

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This landscape scale invasive control and restoration project as well as the unique Starr Ranch education programs were created and are now directed by Dr. Sandy DeSimone (Director of Research and Education), who was the recipient of the 2010 California Invasive Plant Council's Land Manager of the Year award.

Task Progress

Weed Warrior Volunteers

Interns Jenni and Mark wrote final reports and gave their final presentation at the end of May 2012. From April through end of May 2012, they recruited 63 more Weed Warrior volunteers, both kids and adults, for a total of 256 volunteers for 2011-12 who worked a total of 650 hours on riparian invasive removal during 2-3 Saturdays per month. Interns recruited from OneOC and VolunteerMatch online but had their biggest numbers from Irvine Youth Action Team, an after school program for middle school kids. Our current top three riparian invasives for removal are periwinkle (*Vinca major*), English ivy (*Hedera helix)*, and smilo grass (*Piptatherum milaceum)*. Volunteers usually work on *V. major* with hand tools (weeder/diggers).

Riparian Invasive Control

In their invasive control work plan, the interns' goal was to add 0.5 new acres to the current 4.25 acre (0.67 mile) invasive control work area along the 4.72 mile long Bell Creek riparian corridor within Starr Ranch. They planned to spend 1.5 days on maintenance in the "old" work area, 0.5 days on invasive removal in their new area, and 0.5 days on the Bell Canyon roadsides. After initial meetings with interns to make sure they understood goals, they then worked independently on their projects. Unfortunately I didn't detect that they had misunderstood the work plan and in the end added only about 0.1 new acres. We discussed the problem and discovered that they had spent most of their time working on maintaining older work areas and on roadside invasive control. Next year interns will use GPS to mark out their new acreage goal so they clearly see where they're heading.

Riparian Enhancement

Interns summarized their data on herbaceous seeding to find that the high seeding rate for the two target species seeded together (*A. douglasiana* and *P. ramosissima*) resulted in the highest mean cover (about 40%) in their 0.25 square meter plots.

Fig. 1. Seedlings of mugwort and phacelia in April 2012 that were planted by interns in January 2012

Fig. 2. By mid July 2012 the January seeding resulted in high cover of mugwort (shown here). The phacelia seedings were less successful.

Survival rates for end of May 2012 for the 200 native woody cuttings planted end of January by interns, 40 each of five native riparian trees and shrubs ranged from 89% (*Rubus urcinus*) to 100% (*Baccharis salicifolia)*.

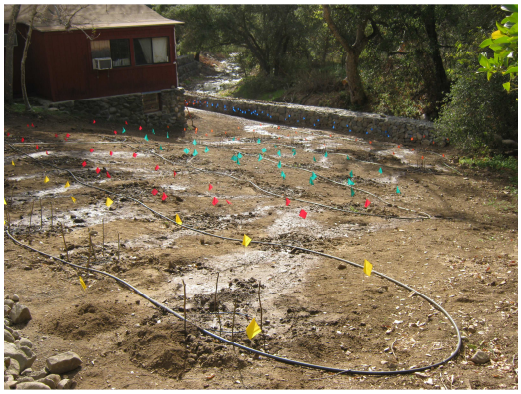

Fig. 3. Irrigation set up, February 2012.

Fig. 4. Cuttings in mid July, 2012.

Bell Canyon Target Species Mapping

Interns Jenni and Mark completed walking the 4.71 mile length of Bell Creek and removed a lot of tree tobacco that had sprouted since 2010-11 flooding and also several tamarisk, mulberry saplings, bull thistle, and one Himalayan blackberry. They completed mapping olive (*Olea europaea)*, palm (*Washingtonia robusta)*, giant reed (*Arundo donax)* (not yet found on Starr Ranch), and pampas grass (*Cortaderia* spp).

Aquatic Vertebrate and Perennial Pool Sampling

From June 6 - June 17 we sampled two, 250 m long reaches, in each of the three regions of Bell Creek (south, middle, north). Dryer than normal conditions this previous winter resulted in low flow conditions at the time of sampling, and flow was greatly reduced from the same sample period in 2011. Despite these low water levels, anuran larvae, metamorphs, and adults were still present, and California treefrogs (*Pseudacris cadaverina*) and Pacific treefrogs (*Pseudacris regilla*) were detected in all three regions of the creek. Additionally, California newt (*Taricha torosa*) adults were once again found in the north region, while two species of fish (arroyo chub (*Gila orcuttii*) and threespine stickleback (*Gasterosteus aculeatus*)), were detected in the middle and south regions.

Lower than average rainfall this year will likely make the upcoming 2012 perennial pool survey in late summer/early fall especially effective for identifying sources of water that persist year-round in Bell Canyon.

Stream Bioassessment

We completed our annual Bioassessment to assess the effect of urban runoff on Bell Creek during May 23 - 24. Benthic macroinvertebrate samples from both sample sites in Bell Creek were sent out for professional identification in mid-June and results should be returned to us by early 2013.

Orange County Conservation Corps

The Orange County Conservation Corps crew stopped work on olive removal during songbird breeding season. We hope to bring them back in 2012-13.

Upland Invasive Species Control and Rare Habitat Restoration

The five person seasonal upland field crew added three new artichoke thistle (*Cynara cardunculus)* control sites (15.1 total acres after one site was cut back by three acres) for the 2011-12 season. The crew is now finishing up monitoring data and we'll begin to do data summaries for the season. Even though precipitation for 2011-12 was only 9.36", we had success in all three of our active coastal sage scrub restoration sites (15.6 acres) and though the passive monitoring data has not yet been summarized, it does appear that native shrubs expanded into weed treatment areas.

Project Director Public Talks

In April, the project director spoke on Starr Ranch restoration and education projects at a meeting of the Orange County chapter of the CA Native Plant Society. Staff from the 20,000 acre Rancho Mission Viejo Land Trust visited Starr Ranch to learn about our restoration projects in July.

Invasive Control, Restoration, Monitoring, and Education at Audubon Starr Ranch Sanctuary

October 2012 Quarterly Report: due October 31, 2012
Project Director: Sandy DeSimone
Watershed: San Juan Creek

Brief Description of Project

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Task Progress

Weed Warrior Volunteers

The Riparian Interns hired for 2012-13, Andrew Battles and Maranda Miller, arrived to start work on October 15. They'll soon begin to recruit new Weed Warrior volunteers for 15 Saturdays from November through May.

Riparian Invasive Control

July through October are "down" months for invasive control, since the seasonal staff has departed, soils are hard, and temperatures are high. The new interns will soon begin invasive control in Bell Creek. We plan to add 1 – 1.5 new riparian acres to our 4.5 acre intensive weed control area this year. Our target acreage for intensive control of priority invasives is currently 11 acres.

Riparian Enhancement

We continue to irrigate the herbaceous seeding plots, and plants are doing well (Fig. 2).

Fig. 1. Seedlings of mugwort and phacelia in April 2012 that were planted by interns in January 2012

Fig. 2. January seeding plots in October 2012.

Native woody cuttings also receive drip irrigation and look healthy (Fig. 4).

Fig. 3. Irrigation set up, February 2012.

Fig. 4. Cuttings in mid July, 2012.

Bell Canyon Target Species Mapping

The new interns will expand the mapping area to the entire 125 acres Bell Creek riparian corridor. This acreage is based on the most common definition we've found of "riparian": 100 feet from the creek center line to both banks.

Aquatic Vertebrate and Perennial Pool Sampling

On September 22, teen volunteers from our srjb4 group assisted with perennial pool sampling as we surveyed the southern half Bell Creek. As expected, dryer than normal winter conditions resulted in long stretches of dry creek. However, two reaches did hold water, confirming observations from 2011. Additionally, both of these reaches contained fish, suggesting they did not dry at any point during the summer. The north half of Bell Creek was sampled on September 27, and several of the reaches possessing water in 2011 were found to now be dry. Our survey of the north portion of Bell Creek returned only one several hundred meter stretch of flowing water and two small discrete pools.

Data from both the aquatic vertebrate and perennial pool surveys are currently being tabulated in preparation for analysis and map production.

Stream Bioassessment

Samples were submitted to a taxonomist for macroinvertebrate identification. Once we receive the data, we'll begin data analysis.

Orange County Conservation Corps

The Orange County Conservation Corps crew stopped work on olive removal during songbird breeding season. We hope to bring them back in 2012-13.

Upland Invasive Species Control and Rare Habitat Restoration

The 2012-13 upland crew started arriving in late September. The Field Crew Leader mapped new invasive control sites and in mid October began seeding in two sites totaling 11 acres. Once rains begin, the five person seasonal field crew will begin visiting sites regularly for non-chemical invasive species control.

Project Director Public Talks

The Project Director participated on a panel of three academic scientists and three land managers at the Cal-IPC 2012 annual meeting (October 2012). The topic was novel and hybrid ecosystems. The early online view of an opinion paper by the project director (to be published in *Restoration Ecology*) appeared in October 2012. She also gave a talk on Starr Ranch restoration and education at a meeting of the local Sea and Sage Audubon Chpater.