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DIGGING IN: A GUIDE TO COMMUNITY-BASED HABITAT RESTORATION

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A Guide to Community-Based Habitat Restoration

Kristina Finstad, Christiane Parry, and Eben Schwartz

CALIFORNIA COASTAL COMMISSION
THE TIDES CENTER
MARINE EDUCATION PROJECT

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The Tides Center is the nation's leading values-based sponsor of social innovation, Tides Center partners with individuals, groups, and funders to implement programs that accelerate positive social change. The Tides Center Marine Education Project is dedicated to preserving and restoring the biodiversity and health of California's coastal and marine ecosystems through scientifically-supported community involvement, education, and action.

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Why Restore?

In California, population growth and associated coastal development have caused the loss of over 90 percent of our wetlands.

HABITAT DESTRUCTION AND DEGRADATION are among our most serious environmental crises, causing species extinctions and threatening many remaining wildlife populations around the world. In California, population growth and associated coastal development have caused the loss of over 90 percent of our wetlands. Although the passage of environmental laws in the 1970s, including the California Coastal Act, has helped to slow this decline, many remaining wetlands continue to be threatened by development and are degraded by poor water quality, invasive species, and other threats. In addition to making sure that no more loss occurs, an important new challenge is to restore wetlands and other critical habitat wherever feasible. This guide describes how citizens can become involved in helping to improve and restore coastal wetlands and other coastal habitat in their communities.

The California Coastal Commission's Community-Based Restoration and Education Program

In 1972, the citizens of California passed Proposition 20, known as the "Save the Coast" initiative, which called for the formation of a statewide planning and regulatory agency named the California Coastal Zone Conservation Commission. Made permanent by the 1976 Coastal Act, and now known as the California Coastal Commission, the Commission has spent the past 30 years working to preserve and protect the resources of our 1,100 miles of coastline. The Commission's Public Education Program complements the work of its regulatory and planning programs by empowering the public to become stewards of our coast and ocean and take environmentally positive action. Participating in hands-on habitat restoration is one of the ways in which the public can be involved in helping to protect the coast.

Restoration is . . .

". . . turning back the clock to a time of pre-disturbance ecology." —JOY ZEDLER

". . . raising the ecological function of a degraded site." —DANIEL JANZEN

". . . assisting the recovery of an ecosystem that has been damaged." —SOCIETY FOR ECOLOGICAL RESTORATION

In 2002, the Coastal Commission, working with the Tides Center, a San Francisco-based non-profit organization, developed a habitat restoration program called the Community-Based Restoration and Education Program. Our pilot program, known as "ROOTS," is located at Upper Newport Bay in Orange County, southern California's largest estuary. ROOTS is a team effort involving the state Department of Fish and Game, Orange County, the City of Newport Beach, the Newport Bay Naturalists and Friends, and other organizations. The Restoration and Education Program coordinates monthly field days and weekly greenhouse work for volunteers. Beginning with a basic plan for restoration of three to four major sites around the Bay, the Program quickly grew to eight separate sites and has so far restored over 12 acres of coastal sage scrub, salt marsh, and riparian habitats. Over 4,000 volunteers have devoted more than 25,000 hours to this effort. To date, they have removed about 100 tons of invasives, and cultivated and planted 12,000 native plants. Recently, the Program developed a complementary high school curriculum, *Our Wetlands, Our World*, to help teachers meet state educational content standards with activities that bring the Bay into the classrooms and hearts of students. (Visit **www.coast4u.org** for a free download.). This Guide is an outgrowth of our work at Upper Newport Bay, incorporating the lessons learned along the way.

The Value and Limits of Ecological Restoration

Ecological restoration is an evolving field, and as such, its definition is debated. For our purposes, ecological restoration is defined as an intentional activity that pilots a damaged site towards recovery and sustainable ecological function. Clearly, restoration is no substitute for preservation. It may not be possible to replicate historic functions and values, and the activities of ecological restoration—disking soil, using chemicals to remove exotics, irrigating—can further strain an already stressed ecosystem. However, in many situations, ecological restoration can improve habitat value and ecosystem functions. Ecological restoration is also valuable for the links it forms between huma ns and nature. Ecological restoration can help build a long-term commitment between a natural place and the community that surrounds it.

The majority of restoration efforts occur on disturbed and degraded landscapes. Humans have been "disturbing" biology and land for over 10,000 years. Fortunately, relics of ecosystems with varying degrees of disturbance still exist, as there remains great value in partially disturbed

land. Even small, isolated habitats should not be overlooked for the opportunities they afford; habitat patches are vital to migrating birds and other wildlife, for example. The value of habitat patches that act as corridors and linkages, and the role these linkages play in the survival of populations, is only beginning to be fully understood by ecologists. Sadly, however, there are some places that are beyond restoration due to challenges such as isolation from functioning ecosystems or inadequate soils.

mportance of Wetlands

"Wetland" is a broad term used to describe areas where, at least some of the time, water saturates the soil, and which display characteristic soil and vegetation types. These habitats are among the most productive ecosystems on earth—an immense variety of microbes, plants, insects, amphibians, reptiles, birds, fish, and mammals needs wetlands for part or all of the lifecycle. According to the U.S. Environmental Protection Agency, more than one-third of United States' threatened and endangered species live only in wetlands, and nearly half use wetlands at some point in their lives. Wetlands benefit both freshwater and marine fisheries by providing spawning and rearing habitats and food supply. Waterfowl migrating along the Pacific Flyway depend on California wetlands for critical wintering habitat. Wetlands also serve vital hydrological functions, buffering wave erosion, reducing flooding by storing large volumes of water, and filtering toxic run-off.

Yet only ten percent of California's wetlands remain, and many of these last existing patches are degraded or threatened by human activities. The term "wetland" was not coined until the 1950s. Prior to that, these lands were known as "swamps" and were largely considered nuisance lands—in need of being converted to "useful" purposes. It was not until the 1970s that environmental laws such as the Clean Water Act reined in the wholesale destruction of wetlands for shopping centers, homes, and farmland. In southern California, most of our remaining coastal wetlands are hydrologically constrained by railroads and roads. Upland buffers, which filter sediment, provide habitat, and protect wetlands from human and animal use, have been eliminated or are degraded by invasive plants. Many of the waterways that feed into

PHOTO: MARK WARMERDAM

Wetlands at Point Reyes National Seashore

wetlands are polluted by urban waste and pesticides, heavy metals, and high bacteria counts. Other threats included lack of freshwater inputs due to dams, sedimentation caused by upstream and bordering development, and destruction caused by overuse or disturbance and trampling by humans and animals.

Purpose and Scope of this Guide

While there are many types of coastal habitats in California, the focus of this guide is on wetlands and their associated transitional and upland habitats, which buffer the impact of surrounding developed zones and have intrinsic habitat value as part of the wetland ecosystem. Examples of habitats that fit well into the compass of this guide are marshes, coastal sage scrub, grassland, creeks and riparian corridors.

The purpose of this guide is to assist inspired individuals and organizations in undertaking community-based habitat restoration projects, and to help maximize the success of these projects. The guide is designed for people who seek to develop new programs, but may also be helpful in expanding or improving an existing program. The guide explains, in easy-to-follow instructions, the basic steps of information gathering, site selection, team building, project implementation, monitoring, maintenance, and working with volunteers. Also included are tips on battling non-natives, as well as propagating and installing native plants. While this guide is focused on the Commission's experiences in marshes, creeks, and coastal sage scrub communities, we reference several other coastal habitat types as well.

The guide provides insight into how to develop a coastal habitat restoration project that can be undertaken with volunteer labor, with direction towards additional resources where needed. It is not intended to provide enough technical information for you to complete a restoration project through the use of this guide alone. Each restoration site is going to have particular issues and design considerations that cannot be addressed through a generic guide. Depending on the scope of your project, you may need to hire outside expertise to develop a restoration plan for your specific project. If this is the case, this guide will help you to work with your expert(s) as a partner, providing critical information and input.

We hope that this guide will help you develop and maintain a successful community-based habitat restoration program, and in the process help to restore our remaining coastal wetlands to places of vitality and beauty.

Build a Foundation

PLANNING YOUR PROGRAM is the most important step to take towards ensuring the successful restoration of your local habitat. Advanced planning will save time and money and prevent most mistakes. In this section, we will discuss the basics of planning and establishing a community-based habitat restoration program, including: selecting a site(s), gathering information, establishing an advisory committee, and planning and setting goals for your program.

Site Selection

You may have a location in mind for a restoration project. The factors outlined in this section will help you evaluate your choice and select the best site(s) for your unique situation.

Perhaps the most important characteristic of a successful restoration site is connection to functioning habitat, an area that will provide a seed source and wildlife corridor. Your project should work outwards from undisturbed areas—from where the ecosystem is closest to its natural condition to areas that can be recovered by community-based efforts. Try to design your restoration work so that it strengthens the link between functioning habitats. By providing a channel for wildlife movement and seed dispersal, you will greatly increase the function and recovery rate of the restoration site.

Documents such as Management Plans—available from local resource agencies—often contain prioritized lists of restoration sites and suggested remedies. If you choose your project site from such a list you may be able to take advantage of existing studies.

There are a number of important factors to consider when settling on a site for your program:

Steps in the Planning Process

- Choose a project site
- Gather historic and existing information on the watershed
- Set goals with specific objectives and target criteria
- Prepare a Project Plan
- Formulate a budget
- Apply for appropriate permits
- Publicize the project

Perhaps the most important characteristic of a successful restoration site is connection to functioning habitat.

1. **Land Ownership and Agency Requirements.** Before any work is undertaken, you need to establish who owns and/or manages the land you wish to restore, so that you can determine your rights to access and what restrictions might apply. Talk to the city or county planning department where your site is located—they should be able to give you information on land ownership and management of your site. Your wetland of choice may have more than one owner/land manager. For example, Orange County, the State of California, and the City of Newport Beach all own and manage land in Upper Newport Bay. In addition, consultation with planning agency/land management staff should provide an idea as to the resources present in your proposed site, and what you might need to look out for, including permit requirements (more details on permitting later in this section).

2. **Hydrology and Topography.** You will want to carefully examine your prospective location for its environmental factors, such as the amount of rainfall it receives on average, and its probability of flooding. There can be a wide variety of possibilities based on very small differences in location. Additionally, the direction and aspect of the slope itself are important in determining how much sunlight the area receives, how much runoff it might accumulate, etc.

3. **Soil.** The quality of the soil is critical. Restoration work requires soils with the right chemistry and drainage capabilities in order for native plants to take root. Even with perfect chemistry and drainage, however, soils that once served as roads or dumpsites could be too compact or polluted for native revegetation at this time.

4. **Flora and Fauna.** The type of vegetation and wildlife that currently exists on site can help determine not only the potential success of your program, but also the importance of undertaking it. The presence of non-native species is the first signal that restoration may be needed, and the presence of endangered species may add greater urgency to the need to take on that project. However, the presence of herbivores such as cows and deer can limit the ability of native plants to become established. Review the California Department of Fish and Game California Natural Diversity Database for the region (which can be found here: **http://www.dfg.ca.gov/bdb/html/cnddb.html**).

5. **Suitability for Volunteers.** In all of your planning, keep in mind the workers that will be performing the restoration. Not all activities or

locations are suitable for volunteer labor. For example, eradicating an invasive stand of Brazilian Pepper trees may involve heavy equipment and chemicals that are not appropriate for volunteers with limited training. Select sites that are accessible and for which the likely restoration activities can largely be satisfied using volunteers.

In every step of the planning process, remain flexible. Not only will unforeseen circumstances arise, but the habitat itself will present new challenges as it is being restored. You cannot predict every possibility, so try to remain as open to change as possible while keeping your long-term project goals in sight.

nformation Gathering

Once you have selected a general location for your restoration project, gather as much information as possible about the watershed and surrounding area in which your site is located. Your specific project area and restoration activities will be greatly influenced by the activities and environment in the surrounding region

It is helpful to compare historic and current aerial photographs, and conduct interviews with local longtime residents, to address changes over time that might influence your project goals and objectives. For example, by interviewing residents in Newport Beach, ROOTS was able to locate a natural spring, hidden within a new housing development, which inspired the planning of a riparian restoration project. By studying the Bay's history as a dredging site for shell fragments and salt ponds, we were able to identify the causes of topographical and soil chemistry changes. Historic descriptions of intact ecosystems may be used to establish target conditions for a restoration project, or to classify appropriate locations to create habitat. In addition, information gathered on prior uses (and abuses) of the area will help you recognize obstacles and opportunities.

Aerial photographs and topographic maps will also help you identify the watershed within which your project site sits, and can help you identify other features upstream from your site. Local government agencies and university mapping libraries will be able to direct you to aerial photographs of your watershed, which will indicate drainage patterns and topography, as well as vegetation cover and land use. Identifying vegetated areas will help you determine the drainage patterns and flow for your project site. Surveying these areas may provide even further clues; functioning habitats within the watershed may provide evidence as to what your project site may be capable of and what it may need.

Restoration Resources

The Southern California Wetlands Recovery Project provides a variety of resources for restoration projects, including tools, training, and funding. Its local task forces in San Diego, Orange, Los Angeles, Ventura, and Santa Barbara counties, are open to all and provide a forum for sharing information and networking. Find out more about the project at **www.scwrp.org**.

There are many ways to educate yourself about the ecology of an area. A good place to start is the California Wetlands Information System, developed by the California Resources Agency and available online at **www.ceres.ca.gov/wetlands.** It is a compilation of public and private sector information, including maps, environmental documents, agency roles in wetlands management, restoration and mitigation activities, regulatory permitting, and wetland policies. Another good resource is the California Natural Diversity Database, mentioned earlier. Next, consult with the public agencies that have jurisdiction over your site, including city, county, state and federal agencies. If you are unsure of which agencies have jurisdiction, start with the local planning agency and ask them to direct you onwards. In addition, state agencies such as the California Department of Fish and Game, the Coastal Commission, the Coastal Conservancy, the Regional Water Quality Control Boards, and the California Department of Parks and Recreation may be involved. Federal agencies involved in wetlands management and regulation include the U. S. Fish and Wildlife Service, the Army Corps of Engineers, and the National Marine Fisheries Service.

Published documents, such as Management Plans, Environmental Impact Reports and Statements, General Plans, and others, all of which are available to the public (usually on-line or for viewing at Agency offices), can provide valuable ecological and historical information. Beyond these public resources, there are likely numerous non-profit organizations, committees, and clubs that have an interest in your restoration site or the surrounding watershed. Agency staff may be able to help identify these groups, as will a simple internet search on the wetland name. Environmental groups, Master Gardeners, Natural History Museums, and Botanical Gardens in the area may have an interest in your project. Attending and participating in those groups' meetings is a great way to broaden your knowledge and recruit helpful partners.

The Restoration Community

Roots stays involved with the restoration community through the Orange County Coastal Coalition, a group that brings together concerned citizens, non-profit leaders, students, and agency representatives from city, county, state, and federal levels. We also participate in the Newport Bay Management Coalition, a group composed of those making decisions for the Bay, including the local and state land managers. Surrounding yourself with people who are knowledgeable about your project area, community, issues, and who have restoration experience is a way to continually gather information that will be helpful to your project.

Developing Your Project Team

Your project team will include the staff that will provide the day-to-day oversight and management of the restoration work and public outreach, advisors to the project, and other organizations and groups with whom you will work closely.

Staffing: We recommend that the responsibility and authority for project management and coordination be invested in one key staff person—the

project coordinator. The project coordinator must have a clear understanding of the goals and duration of the project and how it fits into the missions of participating agencies, organizations, and sponsors. A variety of skills and abilities come into play in order for the coordinator to be successful: leadership, restoration experience, organizational skill, budgeting, a strong grasp of the scientific and technical issues involved in restoration, human relations, communication, and flexibility. Other relevant skills included fundraising and media relations. Not all of these skills need to be found in a single person, however. Partners on the Advisory Team (see below) can contribute their skills and efforts to help supplement the abilities of the coordinator and ensure that all facets of project management are covered. You may also consider hiring consultants to fill gaps in your Project Team's skill set, depending on the complexity of the project.

Stakeholder Groups: Existing groups and organizations involved in your project site can help create a foundation for success. These groups should be viewed as partners in your efforts.

If there is already a group involved in restoration work in your watershed or nearby, meet with the group members early on to discuss how you can work together to fulfill your goals and complement each other's efforts. You may want to volunteer with them to see how they operate and find out what obstacles they face that your project may also encounter.

Existing non-profit volunteer groups may have taken on fundraising, maintenance, and/or educational roles at the site. Find out who they are, what they are doing, and how you can help each other fulfill your objectives. For example, ROOTS provides a niche for the Upper Newport Bay Naturalists and Friends to participate in organized restoration activities, which in turn provides ROOTS with a core group of trained, committed volunteers that can serve as leaders at restoration events. Similarly, the UC Cooperative Extension Master Gardener's program plays a major role in our native plant nursery, installing irrigation systems, mixing potting soils, and providing important expertise. Likewise, we contribute to the Master Gardener's program by injecting a native plant theme into their landscaping. These groups or public agencies may also have resources that are available for your use, like equipment, meeting space, or free training. ROOTS has had tremendous support in these ways from the local offices of the Department of Fish and Game, the County of Orange, and the City of Newport Beach.

Advisory Team: A core group of key stakeholder groups, including agency staff, scientists, elected officials, environmental groups, landowners, and

Getting in Step

The EPA has an excellent guidebook, ***Getting In Step: Engaging and Involving Stakeholders in Your Watershed,*** available for free download at: **www.epa.gov/owow/watershed/outreach/documents.**

local citizens, will form your Advisory Team. The Advisory Team can help guide your program with technical expertise and assist in coordinating your program with the needs of the community. Ensuring the involvement of all partners is crucial to community involvement and stakeholder support, without which your project has little chance of succeeding.

A multi-disciplinary advisory group with a range of expertise is essential. The bigger your umbrella is—that is, the more points of view that are represented—the more likely it is that you will come up with the most creative and beneficial course for the habitat you are trying to protect.

Once identified, bring the members of your Advisory Team together for an initial meeting. At this first meeting, introduce yourself and your ideas, explaining why you have chosen to take on your project. Give over most of the meeting to conversations with your team. (See Appendix A for a sample Kick-Off Meeting agenda.) Brainstorming together and developing a rough set of goals will help to build a sense of trust and teamwork, and will facilitate further participation from the group; after all, no one wants to bother participating in an Advisory Team in which their opinions are not sought, or worse, are ignored.

Advisors can help with a variety of facets of the project. For example, the advisory group may establish technical teams to provide information on topics that require specific knowledge and abilities, such as soliciting financial aid, coordinating public outreach, or providing scientific support.

Building partnerships can be challenging, and keeping your team motivated takes work. Try to spend time with your advisors outside of the meetings if possible, in order to get to know them and their motivations for helping with the project.

Why form an Advisory Group?

- Defining project goals
- Restoration activities planning
- Coordinating plan implementation and schedule
- Identifying public interest in the project and respecting values
- Bringing diverse viewpoints and issues before decision makers

Four Stages of Partnership

Know Your Watershed, a resource from the Conservation Technology Information Center, identifies four stages to partnership: forming, storming, normalizing, and performing. See their website for detailed advice on developing successful partnerships in your watershed: **www.ctic.purdue.edu/KYW/Brochures/BuildingLocal.html.**

Setting Goals

Over the course of several (or just one, if you are lucky!) meetings, your staff and Advisory Team should seek to establish a common vision for the desired future condition of your project area. This vision is your project's primary goal: it should reflect the priorities of agencies responsible for managing lands within the target area, as well as concerns of local citizens. This goal should also take into account an assessment of future development possibilities in the watershed as well as the political, social, and economic values of the community.

An example of a primary goal for habitat restoration articulated by the Society for Ecological Restoration is: "to heal damaged habitats towards greater ecological function through re-creation of natural conditions, often over a long period of time." However, historical conditions may no longer be feasible in your project area, and remnant patches of undisturbed habitat may not exist for reference. Goals should recognize constraints such as those imposed by the geography of the project site, any special needs found when collecting baseline data, budget and staff requirements, and the ability to receive the appropriate permits. Recognizing these factors will assist in identifying realistic project goals.

Example of a Primary Goal

". . .to heal damaged habitats towards greater ecological function through re-creation of natural conditions, often over a long period of time."

—SOCIETY FOR ECOLOGICAL RESTORATION

In addition to identifying an overall primary goal for your project, you may wish to specify secondary goals. Volunteer involvement is one such goal that sets restrictions on the types of projects that can be undertaken. ROOTS limits its projects to simple revegetation projects in areas that are accessible by vehicle for watering, avoiding steep slopes and treacherous geologic features in order to allow volunteer participation.

Reference sites—areas that represent pre-disturbance conditions—can be used to help set goals. Comparable sites should have similar landscape position (slope-direction, elevation, proximity to the ocean) and be nearby. These reference habitats should exhibit the functions that you seek to restore in your project site, and can be used as models to design your efforts. By collecting plant coverage data in a reference habitat, you can design a similar plant palette for your site and set suitable goals for how that habitat should function (see Monitoring and Maintenance section). There may be other groups that already have data for a suitable reference site—other project managers (hopefully from within your Advisory Team) may help explain what to expect from your site over time.

In addition to primary and secondary project goals, establish a series of *objectives* and *target criteria*. If the goal is the ultimate destination for your project, then you can imagine objectives to be the mileposts that you pass along the way to your goal. They should be achievable and measurable. Target criteria are the tools used to measure progress towards your objectives. A list of objectives will be useful in explaining your project to partners and funders, and will provide a scorecard to share accomplishments. If your goal is to provide native habitat, appropriate objectives may include:

- Remove invasive species
- Collect and disperse seeds

- Install native plants
- Re-establish dominance of the native plant community

Use target criteria to measure progress towards your objectives and track success. Target criteria should be measurable, the methods used to collect data should be repeatable, and the results should be comparable over time. For example, ROOTS keeps track of the pounds of weeds removed at each event, and the number of native plants installed. These metrics help explain our success to our project partners and the community. A short sentence in a local newsletter or newspaper, like, "fifty-four ROOTS volunteers removed two tons of ice plant from the Bayview restoration site on Saturday," can speak volumes. Adding a timeline to your established criterion will help to keep you on task, as well; for example, "limit exotic species coverage to 40 percent within one year." The closer you can tie the target criteria to your objectives, the easier it will be to judge the success of your efforts.

The restoration plan should include the following elements:

- Project description, goals, and objectives (characterization of desired habitat).
- Site map with target restoration areas delineated (with topographical information).
- Existing site conditions.
- Plant species list, including quantities, spacing, and percent of community (plant palette).
- Site Preparation (e.g., weed eradication, soil amendments).
- Plant Installation Plan.
- Maintenance Plan (including an irrigation plan and an exotic/invasive plant eradication plan).
- Monitoring Plan (including performance criteria and a sampling plan).
- Timelines for all activities (taking into account seasonal considerations for site preparation, planting, and maintenance).

Developing a Restoration Plan

An important step in project planning is to develop a written restoration plan. This plan will guide your restoration work, as well as the monitoring and maintaining of your restored sites. If resources permit, consider hiring an expert to draft your plan. An ecological consulting firm or individual consultant with restoration planning experience can provide scientific underpinnings for your project and help make it a success. Look for a consultant who has local restoration experience, ideally within the same watershed.

The information that you have already collected about the site, as well as your goals and objectives, will help inform the restoration planning process. If you do hire an expert, this relationship can be a valuable learning opportunity for you and any other staff involved in your project. ROOTS staff shadowed our ecological consultants as they collected data on-site, and the firm provided training (for staff and for the community) in native plant propagation as part of our contract.

The ROOTS restoration plan includes three experiments, one to test different methods for removal of invasive species, one to determine the best watering techniques for coastal sage scrub habitat, and one to test the effectiveness of different willow planting techniques. On-site experiments provide several benefits: you will gain information that will help improve the success of your restoration work; you can offer that

information to others to help other habitat restoration efforts; and with descriptive signage, they offer a way to engage the community's interest, and to educate the public about the field of restoration science. (See Appendix B for a copy of ROOTS' restoration plan.)

Other Planning Considerations

In the midst of all this planning, remember that habitat has its own schedule, and it may not conform to the one you have set out, no matter how well you have planned in advance. The target criteria for one of ROOTS' projects was native plant dominance in three years, but after installing the first season of plants we learned the soil had not recovered from the seven tons of ice plant we had to remove first. We pushed the planting schedule back two years to give the soil time to recover its native alkalinity. Other potential limiting factors around which you may need to plan include impacts from livestock or trespassing humans, and recreational use or trail development. Plan for these possibilities with fencing or by posting signs to let the public know what you are doing, and how important it is that they tread lightly.

Overall project duration can vary greatly. While, depending on the scope and complexity of your project, the planning, site preparation, and installation can often be accomplished in several years, the amount of time required for monitoring and maintenance can extend a project's timeframe significantly (see Monitoring and Maintenance Chapter, p. 35).

Be aware that not every project will be a success, and that perceived failure is often the result of our own clock-watching. Nature takes time to heal and the selected project site may not be ready to absorb the benefits of restoration. However, by planning your project thoroughly ahead of time, you can avoid many of the common mistakes made in restoration work. ROOTS' first project did not meet our objectives because we did not yet have the volunteer support to realize the watering and weeding schedule. Your planning process and Advisory Team can help anticipate many such problems and establish realistic goals and objectives for your work.

Some tips to help you avoid common pitfalls:

1. Start with a small, accessible, restorable site.
2. Avoid sites with severely disturbed soils.
3. Follow species-specific weeding timing and techniques.
4. Choose plants that can tolerate site-specific soils and hydrology.
5. Plant pioneer species (sun-loving, soil-fixing herbaceous plants) before climax species.
6. Be ready for the planting season—propagate plants in summer for winter planting.
7. Take "before" pictures.
8. Prepare the site before you plant it (weed-control, soil-amendment).
9. Allow plenty of growing room—don't over plant the site.
10. Cage tasty plants to keep them safe from vegetation-loving predators.
11. Visit the site frequently to check on progress and maintenance needs.
12. Plan ahead for these critical, time-consuming factors: Weeding non-natives (spring); Watering (summer).

Budget and Fundraising

As your plan develops and specific actions take shape, you can begin to assemble your budget. Cost estimates should include salaries, contracts, operating and equipment expenses, and long-term monitoring and maintenance costs. *A Primer on Habitat Projects*, made available by Shared Strategy for Puget Sound at **www.sharedsalmonstrategy.org/files/PrimeronHabitatProjectCosts.pdf**, can help predict costs for specific actions. An accurate budget is essential, not only for helping to understand what costs your project is facing, but also in applying for funds to help cover those costs.

An accurate budget is essential, not only for helping to understand what costs your project is facing, but also in applying for funds to help cover those costs.

Some funders will want to help with your entire project, but others have more focused interests. An important element of securing funding from these groups is to apply for funding for specific activities within the overall project. Categorize specific tasks that are part of the restoration, such as project design, education and outreach, site preparation, planting, and monitoring activities; then determine how much each activity will cost.

Your project will most likely qualify for grant funding, assuming that you are established as a non-profit, either on your own or through fiscal management by another non-profit organization. The US EPA has a grant writing tutorial software tool that walks you through the grant-writing process and helps you learn to write more competitive grants. You can find this tool at: **www.purdue.edu/envirosoft/grants.html**. (A list of funding resources is in Appendix C.)

Permits

Each restoration effort has unique regulatory requirements, ranging from a full set of local, county, state, and federal permits, to none at all, depending on the amount of land and water disturbance, species present, and other factors. Permits are required by regulatory agencies for work on wetland or riparian areas in order to protect the integrity of these ecosystems.

Small-scale projects with minimal disturbance (no heavy equipment) may not require any permits. However, always seek permission from the landowner. ROOTS applies for project approvals with three different agencies, depending on the location of the site within Upper Newport Bay: the California Department of Fish and Game, the County

of Orange, and the City of Newport Beach. We developed an application form including basic project plan elements for approval from the appropriate agency before project implementation. This is a useful tool for all involved—it allows the agency to know your plans and offer assistance, and it helps you plan the event beforehand so you can anticipate the day and prepare appropriately. (See Appendix D for a sample.)

Even small-scale projects can encounter unexpected circumstances that may require agency assistance. For example, many Native Americans settled beside waterways, and it is common to uncover buried historic and prehistoric artifacts along stream corridors. The Natural Historic Preservation Act requires an archeological study if a site is suspected to hold cultural resources. If you encounter archeologically significant grounds unexpectedly, contact the local agency's planning department and follow their direction before continuing with project implementation.

To avoid conflicts with legal requirements, discuss your project goals with resource management agencies early in the process. To the extent possible, avoid excessive environmental impacts such as earth moving, which can promote erosion, and widespread vegetation removal, which can adversely affect habitat. You should exercise good judgment in timing your actions; avoid disruptive work during nesting seasons and minimize disturbances during rainy periods.

Other Resources

The *Guide to Watershed Project Permitting*, available on-line from the California Association of Resource Conservation Districts (**www.carcd.org/permitting/main.html**), will assist with the basics of the permitting process. The "Wetland Project Permitting Guide," available from the Ventura County Planning Division (**http://157.145.215.100/rma/planning/pdf/prog_servs/bio_resources/FinalPDF.pdf**) is another useful resource.

Dig In

ENOUGH PLANNING—IT IS TIME TO GET STARTED! This next chapter will cover the steps you will need to take during your restoration work: development of a plant palette and planting plan; assessing and, if necessary, amending soils; plant propagation; site preparation; planting; and watering.

Develop Plant Palettes and Planting Plans

Local examples of native habitat will help define the plant palette at your site. In addition, you should consider the vegetative structure and function of the community you are trying to restore. For example, Upper Newport Bay is fringed by a salt marsh community, which is connected to a high marsh community via an ecotone. An ecotone is a mix of two plant assemblages as they come together. Similarly, the high marsh community transitions to coastal sage scrub by an ecotone.

Edge and ecotone habitats are transitional, meaning they represent the gradual change from one community to another, and encourage interaction between ecosystems. In such areas, your plant palette should include a wide variety of plants, culled from the two habitats between which you are creating a transition. Interior habitats, on the other hand, may also possess a variety of plants, but they should all be characteristic of a specific community.

The local landscape will provide clues to what is ecologically feasible for

your project. Spend time in your project area: record plant communities, wildlife sightings, soil appearances, signs of disturbance, and so forth. Try to recognize growth patterns in your reference site(s) that may provide clues for how your project may play out. Data we collected in reference sites indicated that sagebrush could dominate a coastal sage scrub palette. Therefore, we designed our plots accordingly, giving more space for sagebrush to mature in order to prevent competition with the less aggressive natives in our palette, such as monkey flower.

The local landscape will provide clues to what is ecologically feasible for your project.

The general idea is to maximize plant species diversity within the bounds of the community's structure, while keeping the plantings within that community's range. A delineation of a community's range may be accomplished in the field by conducting a vegetation survey to approximate the appropriate geomorphic boundaries for a given community (i.e., tidal marsh fringe for high marsh species, above the high marsh species for coastal sage scrub species or inland locations protected from tidal influence, and in-between for the ecotone mix). Topographical information for your site will also assist in this delineation. Your plant palette will guide how far apart to space the plants and relative abundance of each species within a community.

Soils Assessment

Your soils will also influence your plant palette, as well as site maintenance. One of the most common causes for attrition in plants installed at a restoration site is poor soil quality. It will help if you can take the time to analyze the soils in your project area for their ability to support diverse native plant communities. Testing soil samples can provide valuable information. For example, sites with fine-textured alluvium, such as historic flood plains, will not require fertilization; doing so could actually give invasive species an edge over the natives. Another important factor to note is salinity, often found in areas with a marine influence (such as estuaries) where human-altered flood patterns may no longer provide the annual cleansing of salt that these areas once enjoyed. One solution for salty soils is to plant halophytes: salt-tolerant plants that have adapted to deal with saline environments. Acid soils may have to be treated if the plants prefer neutral or alkaline conditions. Soil testing can also tell you if you need to amend the soil (discussed further on page 29). You can purchase inexpensive testing kits at garden stores, or a laboratory can conduct a more precise analysis for about $70 per sample. A list of soil testing labs can be found at **http://ceventura.ucdavis.edu/ben/avo_handbook/resources/labs.htm.**

Other Resources

The *Guide to Watershed Project Permitting,* available on-line from the California Association of Resource Conservation Districts (**www.carcd.org/permitting/main.html**), will assist with the basics of the permitting process. The "Wetland Project Permitting Guide," available from the Ventura County Planning Division (**http://157.145.215.100/rma/planning/pdf/prog_servs/bio_resources/FinalPDF.pdf**) is another useful resource.

Check with local agencies to determine if there are existing soil surveys for your site. Such surveys may provide a general description of native vegetation appropriate for particular soils. However, since soils are variable across small areas, you should also survey neighboring plant communities or reference sites to find out which species perform best under similar growing conditions.

Plant Propagation or Acquisition

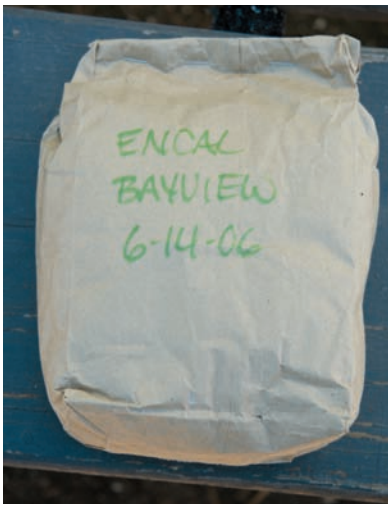
There are a variety of ways to gather a stock of native plants for restoration of your project area. The easiest, of course, is purchasing container stock of seeds from a nursery. However, this can be expensive, and runs the risk of polluting the local gene bank with plants that are not ideally suited for the local environment, even if they are of the same species. A better and cheaper alternative is to propagate your own plants from local seeds and cuttings. Transplanting salvage plants is another alternative discussed in this section.

Collecting Seeds

Collecting seeds is a fun, easy activity for volunteers. Seeds can be used to sprinkle the ground during rain events, or to grow plant stock in the nursery. Start collecting seeds at least a year (or more, if the seed source is limited or if meant for a nursery) in advance of project implementation. As always, check with the local land manager first to ascertain whether or not you will need a permit for this activity. For greatest success, try to collect seeds from sites with characteristics you seek to emulate; for example, if your project is a south-facing cliff restoration site, try to collect seeds from plants growing on a steep slope in full sun. Always try to collect seeds from within the same watershed as your project site, as this will result in plants that have already adapted to the specific conditions to be found there. Avoid collecting at previously restored sites or roadsides. In areas where habitat has been disturbed and transformed, there may be a risk of collecting the wrong species. The same goes for cuttings (discussed later in this chapter.)

A volunteer collects California buckwheat seeds.

Many native plants produce their seeds in the summer. Guide books, such as *Flowering Plants: The Santa Monica Mountains, Coastal & Chaparral Regions of Southern California,*



Collected **Encelia californica** *seeds in labeled bag.*

will often indicate plants' specific seeding times, which is typically after the flowers drop. Use this information to determine when to start collecting seeds, but always vary the plants from which you collect. If you only collect seeds from a plant that typically blooms early, then all of the plants grown from those seeds could be wiped out by one late frost a few years down the road. Gather from many different plants of the same species in the same area to maintain genetic diversity in your stock. Collect the seeds in paper bags labeled with the species name, date, and donor site. Be wary of overzealous collecting, however—you could impact the natural population's ability to sustain itself. Wait until some seeds have fallen on the ground and collect from the same location only every other year. Do not take more than ten percent of any parent plants' seed. Store seeds in paper bags in a cool, dry space. Some collectors utilize a rigorous seed cleaning process, shaking out excess chaff and bugs; this helps avoid the development of rot or fungus, but it may not be necessary if you plan to use the seeds soon (within a year).

Purchasing Seeds

If collecting is not an option for you, seeds can be purchased from native plant nurseries. Nursery staff can recommend a seed mix suited to your site, including broadcast rates. However, as discussed elsewhere in this guide, introducing non-local genes into a restoration site may be problematic—the genetic integrity of surrounding populations may be affected. So, we advise this option be used cautiously, and only when there are no viable alternatives.

If seeds are purchased, check the guaranteed purity. Even a small percentage of weedy seeds that germinate earlier than the native mix can become a problem. If a commercial hydroseed application is used, make sure the hydroseed truck has been cleaned prior to filling it for a new project, to prevent contamination of the seed mix and site.

Preparing Seeds for Planting

Seeds often require specific treatments to emulate their germination period. The coastal sage scrub fire-following plant, *Lotus scoparius*, plays an important role in the recovery of native habitats after a fire. To imitate this natural adaptation in the nursery, ROOTS heats a jar of water and then steeps *Lotus scoparius* seeds for three minutes before spreading them in a flat. (The leftover tea smells delicious!) Another common treatment for California natives, especially those that are fruit bearing, is scarification. In the nursery, you can scratch the seed surface to emulate the digestive system of a predator. Many seeds, however, will not need any treatment to trigger germination. Sagebrush

Above, from top, California native plants: bush sunflower **(Encelia californica);** *California sagebrush* **(Artemisia californica)**

(*Artemisia californica)* and Bush Sunflower (*Encelia californica)* are good examples of natives with seeds that are easy to collect and grow. A good resource on germination details is Dara Emery's book, *Seed Propagation of Native California Plants*. As a general rule, annuals are a good choice for seeding in the field; do not propagate them in the nursery.

Once the seeds are ready for planting, get them ready for their new home. Prepare gardening flats (plastic trays used for propagation) with a seed mix (see below). If the flats spill soil easily through the base, cover with no-color-ink newspapers so that the edges of the flat still drain. There are many brands of starter mix to choose from; a good tip is to expect an "earthy" smell rather than a dirty, fertilized odor. The starter mix needs to be more sterile than a mix used for container stock, so look for brands with more perlite (sponge rock) and fewer organic ingredients. To reuse flats, rinse with a three-percent bleach solution, and then leave the used solution in an open-air container overnight to allow the chemical to evaporate before dumping. Fill the flat nearly full with mix and moisten before adding a complete layer of seed. Sprinkle with mix or sponge rock to a height of ten times the diameter of the seed (not much). Moisten flat with a mister or spray bottle. Mark the species, date of propagation, and seed source on a tag (available in bulk from nurseries) in pencil. Propagate flats in shady zones with good aeration and regular temperatures. In general, seed flats should be watered twice a day, using a light spray so as not to pock the mix surface. Watch your flats carefully and alter the watering regime according to results; water needs will vary by species as well as by seasonal temperature. A sign of over-watering is green growth on the mix surface. If you notice wilting, water more frequently. Seedlings may require less water as they mature. In a couple of weeks, you should see the fruits of your effort as the seedlings emerge from their cases.

Use a mix suited to the plant propagule.

Purchase ingredients in bulk or pre-mixed from garden supply stores.

SEED MIX	CUTTING MIX	CONTAINER MIX
40% sand (washed plaster)	30% perlite	40% potting soil
20% perlite (spongerock #2)	25% vermiculite	40% sand
30% sawdust composted	30% sand	10% perlite
10% native earth (from growing site)	15% peat (break up and moisten)	10% native earth

(a)

(b)

(c)

(d)

Preparing seeds for planting: (a) Lay moistened paper in the bottom of the seed flat; (b) Lay out a complete layer of seeds on top of the soil; (c) Moisten with a mister or spray bottle; (d) Be sure to label completely your seed flat for future reference.

When your new plants have grown up a bit—when the seedlings have at least two leaves—it is time to transplant them to containers. Prepare the container mix (see page 21) and fill small (2"-4") liners three-quarters full, pressing to gently compact. Sprinkle a teaspoon of *mycorrhizae,* a fungus that works symbiotically with the roots of plants to aid the uptake of nutrients, on top. Use a spoon to scoop individual seedlings from the flat. If two seedlings' roots are tangled, transplant them together. Hold the plant over a prepared liner with root tips dangling on the surface of the mix. You want your seedlings' roots to grow down into the container so that they will be prepared to seek out groundwater once installed in the field. Fill the container so the root crown (where the roots meet the stem) is level with the mix. Water the plant, and with fingers on either side of the plant base, press the mix firmly into the container. There should be no air spaces in the mix.

When the plants' roots fill their liners, it is time to transplant into bigger containers, usually a gallon-sized container, or into the ground. Gallon-sized containers are the largest size container stock that should be installed in the field. Check for root binding by lifting the plant out of its container and looking for spiraled roots along the edges and bottom. If the plant is root bound—that is, if the plant's roots are spiraled upon themselves—run a fingernail along the sides and gently pull roots out from the bottom to encourage lengthening in the bigger pot. The plant should grow large enough in this container to be ready for outplanting.

Cuttings

Another option for propagating your own plants is to grow from cuttings of existing plants. If a source of cuttings is available, such as

(a)

(b)

Transplanting: (a) Hold the plant over a prepared liner with root tips dangling on the surface of the mix and then fill in the mix around the roots. This will assure the roots aren't crushed when planted in the pot. (b) A root bound plant.

plants from a reference site, they can be an excellent option that can be reproduced in a greenhouse or even in the field, with less need for irrigation. Cuttings are efficient in erosion protection and sediment trapping, and they root and leaf rapidly to provide habitat. However, they are a form of cloning, and as such, there is no genetic variety in the stock. A monoculture such as this is much less resistant to stresses like drought or disease, whereas a diverse genetic pool provides the greatest chance for adaptation in case of future changes in the local environment.

Cuttings are efficient . . . and they root and leaf rapidly to provide habitat. However, they are a form of cloning, and . . . there is no genetic variety in the stock.

To harvest the plant material, use sharp, clean equipment. Collect hardy stems four or five inches long, not new green growth. As with seeds, use as many different parent plants from as many different source populations as possible to increase the genetic diversity of your stock. Select pieces without flowers or seeds, so that the growing energy is directed to rooting, not reproducing. Snip the base of your cutting at an angle so you know what side is down, and transport wrapped in wet paper towels. Ideally, cuttings will be transferred into flats on the day of collection, but if this in not possible, keep the plant material moist in a refrigerator.

Back at the nursery, prepare flats with cutting mix (see page 21). Prepare the cuttings by removing most or all of the leaves and clip so that they are approximately three inches, no longer than your finger. Prepare the base of the cutting with rooting hormone before installing into the flat. Rooting hormone is a fine powder that promotes root growth, purchased inexpensively at most garden supply stores. Give the base a fresh angle cut (between nodes, if present) to increase surface area contact with rooting hormone. Dip the angled end of your cutting in a cup filled with root hormone, not directly into the product jar, to prevent contamination. Once prepared, use shears or a pencil to guide the cutting into the flat. Cuttings can be packed-in as closely as you like. If there is no misting system in your nursery, spray cuttings with a water bottle frequently (daily). Since the plants cannot uptake water without roots, it is important to keep the mix and leaves damp.

Arroyo willow cuttings about to be transported in a wet paper towel. Note that the end of the willow stake is cut at an angle.

In a few weeks, your cuttings may have sprouted leaves, and hopefully roots. To test readiness to transplant, wedge a fork under a clump of cuttings (or singularly, if they are spaced apart) and pull up—you should feel roots tugging at the flat and holding the clump together. Prepare the container mix and transplant as you would a seedling. If installing cuttings directly into the ground, do so when the plants are dormant, during the winter, in order to reduce the potential for shock.

Purchasing Container Plants

In some cases, you may want to consider purchasing container stock grown by a professional nursery. These plants have some disadvantages—they are expensive, and since they were grown in an environment with all the amenities (temperature regulation, no predators, clean rich soil, and routine watering), they may take time to acclimate to field conditions. However, there may be instances in which plants are needed to supplement stock for an upcoming restoration event. Nursery grown plants can fill that need. We recommend this only as a stop-gap measure, however. As previously mentioned, plants purchased from a nursery may have different genetics from local populations, and therefore could upset the local gene pool with plants that are less well-adapted to site conditions.

We recommend purchasing nursery grown plants as a stop-gap measure only. Plants purchased from a nursery may have different genetics from local populations, and therefore could upset the local gene pool with plants that are less well-adapted to site conditions.

If you do not have the capability of propagating plants onsite, we strongly recommend contracting with a nursery to grow container plants from propagules collected from within the restoration site's watershed. These plants will have similar genetics to those found onsite and should do well. Contract growing usually requires a deposit and can take a year of lead time.

Native shrubs and trees can be purchased in a variety of sizes, from the smallest liners, tubes, or deep pots to large (15-gallon and up) containers. Liners are plastic squares, often six-packs, containing seedlings. Narrow, deep pots and tubes encourage rooting for young plants with long roots, while stubby pots often result in root-bound plants. Tubes, however, can be difficult to store and transport without a tray or case. When choosing potted plants at the nursery, check the roots for binding. Select plants that have not begun to flower or seed so that the energy will go down into the roots instead of up into the flower when installed in the field. Request nursery stock that has been "hardened" or "field adapted" to survive field conditions. Make certain that containers are kept clean of unwanted plant material as well as snails and slugs, to avoid contaminating a site with unwanted species.

For larger container stock, you are better off purchasing gallon-sized plants rather than larger, seemingly stronger plants. Large container plants often grow more slowly than seeds, cuttings, or small containers because

the roots become stunted as they attempt to grow outside of the nursery soil from the pot. One-gallon stock typically attains greater size than fifteen-gallon stock planted at the same time, despite the cost difference. However, larger plants are generally heartier, and once acclimated to new conditions, need less irrigation. The drawback to small containers, cuttings, and seeds is that they are more restricted in their installation window—they need rainfall and cool weather to become established. Small stock is also more vulnerable to damage by animals (including humans) and pests.

If purchased well in advance of a restoration event, store potted plants in a shady area. Watering needs will vary, but watch for the same potential problems you might find in your propagated plants: greening or wilting. It is important to water containers deeply. This means watering and re-watering (and possibly re-watering again) to ensure complete absorbance into container soil. Water the plant for ten seconds, pull the plant out and check for dry spots on the soil. Adjust watering time accordingly. Shallow watering leads to shallow rooting and poor survival—especially for California natives.

Transplanting Salvage Plants

Transplanting natives from areas within your watershed that are on the verge of undergoing alteration is a great way to save plants and money at the same time. Plants can be salvaged from development sites or flood management areas and transplanted to your restoration site. Though this technique has varying degrees of success in terms of plant survival, there are other benefits. When you request the unwanted plants from a builder or agency, you are alerting them to the beneficial attributes of natives. Even if the plant dies once transplanted, the soils and microorganisms that are associated with it, including mycorrhizal fungi, are rescued. Finding these plants can be as simple as walking on to a development site and speaking with the manager. Other potential sites for salvage plants are flood channels, which resource agencies typically clear before heavy rains. Local university arboretums may also have tips on where to find salvage plants.

Try to salvage whole plants and a portion of the soil in which they were rooted (as opposed to collecting seeds or cuttings). Some plants transplant more easily than others. Sages, for example, have shallow, fluffy roots—they transplant more easily than some of the chaparral plants, which often have deep roots. In addition, these plants will have undergone stress during the transplanting process, so use every available method to make the transition easier. With their roots damaged and unable to efficiently capture water, your major goal is to decrease transpiration, or water loss through the leaves. Erect a temporary shade structure, water foliage, and prune back excess growth to help limit transpiration.

Running Large Restoration Events

IN THE NEXT TWO SECTIONS we discuss how to prepare a site and install native plants. These activities are well-suited for volunteer events. Salvaging plants for transplanting, and maintaining restored areas are other activities suited for events. Because every visit to a restoration site brings the potential to disturb existing habitat, it is important that you thoroughly think through your event and address any potential disturbance in advance. Here are some things to keep in mind that relate to using volunteers to accomplish on-site restoration tasks (more about volunteers in the *Involving Your Community* section).

■ **Estimate how many volunteers you will have ahead of time and assign leaders to groups of inexperienced planters.** ROOTS asks that groups of five or more volunteers call in advance so that we have the necessary supplies available, and so that we do not overwhelm a potentially fragile restoration site with too many people. If a large group that you are not prepared for shows up during a restoration event, ask them to come back next time—with reservations—so that you have enough water and activities planned.

■ **Site access and volunteer staging, including a check-in table, supplies, and refreshments, should be located near the work area for convenience, but far enough away from the wetlands or stream to prevent disturbance such as erosion and trampling.** Sensitive areas should be isolated using flags, temporary construction fencing, or stakes and rope. Hardware and home improvement stores generally carry flag posts, about 10 cents each, in several colors. Make sure the boundaries of the restoration area are clear. Use cones to designate the parking area for field trucks in a pre-disturbed location.

■ **If it is necessary for volunteers to walk across a stream, saturated soil, or an area with fragile flora, build a bridge out of weedy debris or plywood.** Rope off steep areas and potential shortcuts to the work site to limit slope disturbance and unauthorized trail development. And naturally, remember to explain all of the markings to volunteers.

■ **Volunteers will need to have a thorough orientation at a staging area near the restoration site before beginning to work.** Each volunteer should know his or her job, and should have a sense of the overall goal for the day. For plant installation, label the plants and map out the planting locations in advance, so volunteers are very clear on where they can and cannot walk, and where and how to install the new plants.

Site Preparation

While your plants are growing, you can prepare your project site for restoration. Depending on the size of your project area, this can be an arduous and time-consuming task, but one for which volunteer effort and community support can make an enormous difference. The most important task associated with site preparation is the removal of non-natives. You may also need to amend the soil.

Eradicating Invasives

According to the U.S. Fish and Wildlife Service, 4,600 acres of habitat are lost in the U.S. each day to invasive species. That means invasive species degrade more habitat each year than urban growth. Consequently, controlling these invaders is a major component of restoration work. A wide variety of factors, including a short life cycle, early reproductive maturity, long distance seed range, acclimation capabilities, rapid response to resource availability, and higher photosynthesis, respiration, and growth rates contribute to invasive species' edge on natives, which allows them to out-compete for moisture, nutrients, sunlight, and space. They can quickly spread out of control because they are no longer controlled by their natural predators. Most of these invasives arrived in the 1880's due to increased agriculture and train use. Today, many invasives come to California from South Africa for landscaping, though the rate of introduction has decreased as the industry has become more educated and regulated.

According to the U.S. Fish and Wildlife Service, 4,600 acres of habitat are lost in the U.S. each day to invasive species.

***Above, from top, common invasive plants in California: pampus grass* (Codateria selloana); *artichoke thistle* (Cynara cardunculus)**

Invasive non-natives should be removed prior to planting and controlled after planting. Ideally, you will have the opportunity to remove these weeds before they have developed seeds, which usually happens in the spring; however, if the weed is an annual that has already set seed, consider mowing to slow down exotic growth, rather than turning the soil to pull out the plant. Try to minimize disturbances of the site as much as possible in order to protect intact natives. If roots must be removed, shake the excess soil off the root-ball and tamp the soil down where it has been lifted. Some more tenacious species, such as field mustard, have established seed banks that could last hundreds of years. Preventing these species from dropping their seeds should be a priority, so be sure to remove these invaders before they develop seeds. In addition, you can encourage deep seed banks to germinate early by performing "grow and kill" cycles multiple times within the same season—encouraging weeds to grow by watering and fertilizing, and then eliminating them by weeding. If your timeline allows, spend at

least two growing seasons removing invasive species to prepare the site before installing natives.

Consider solarization—covering invasives with black plastic during sunny weather—for killing some exotic species, such as ice plant. Solarization avoids the use of chemicals, and dead material can in some cases be left in place for a time, resulting in lighter weight material for removal because the water has been released. One of ROOTS' experiments showed that solarization was a more effective method for removing ice plant that manual weeding.

Above, from top, common invasive plants in California: ice plant or sea fig **(Carpobrotus chilensis);** *sweet fennel* **(Foeniculum vulgare);** *castor bean* **(Ricinus communis)**

If aggressive non-native plants have established themselves across a large area, eradication by a community-based effort may not be feasible. Here, instead of removal, you may opt to employ methods to control the plants' spread by inhibiting their expansion, e.g., by removing seeds before they set.

Small-scale projects should focus eradication efforts on recently invaded sites, which are smaller in size and have shallower weed-seed banks, making the non-native population easier to control. Recently invaded sites have great potential for recovery because their soils may still support the mycorrhizal network that is so important for the growth of native plants. A different strategy will be necessary for large, well-established, aggressive non-natives.

Keep in mind that non-native plants vary in their invasive characteristics, and can therefore be prioritized for removal. Ask local plant experts to help define the most aggressive non-natives invading the area. Another resource to learn more about invasive plants is the California Invasive Plant Council (**www.cal-ipc.org**). Non-native plants that are not directly competing with natives for resources (such as space and water) are lower priorities for removal than invasive plants that are reproducing rapidly and altering native habitat. In fact, non-invasive exotics may be filling valuable habitat roles; your site may be better off with them than without. Bare ground is prone to erosion and is open for more aggressive invaders. In some cases, non-invasive exotic vegetation should be preserved, along with woody debris and stumps, in order to provide habitat and erosion control.

Some invasives, such as *Arundo donax* or *Myoporum laetum*, will resprout from underground rhizomes after the plant has been cut down. By continuing to remove green growth, you may succeed in starving the invader by thwarting photosynthesis. As a last resort, consider EPA-approved herbicides such as Aquamaster to control the most aggressive invaders. Use of herbicides comes with a host of issues, including the long-term persistence of potentially dangerous chemicals

in the environment. As such, it is not an activity to be taken lightly, and it is certainly not an appropriate activity for volunteers. Where herbicides are permitted, carefully supervise the amount applied and check weather forecasts for wind and rain in order to minimize the inadvertent spread of the chemical. Consult the UC Cooperative Extension for technique and timing directives.

Soil amendment

Another possible step in site preparation is amending disturbed soils. Hopefully the soil sampling process discussed earlier has determined if it is needed and if so, what needs to be amended.

One soil amendment that is almost certain to be needed is the replacement of essential microorganisms that might not be present on disturbed soils. Using plant material that has been rooted with mycorrhizae (mycos=fungus, rhiza=root) may reintroduce the appropriate fungi. As mentioned earlier in this section, California native plants are symbiotic with certain species of fungi that penetrate their root tissues and extend into the surrounding soil, capturing moisture and nutrients. Mycorrhizae also acts as an important soil-binding agent, encouraging root growth. Mycorrhyzal inoculent is sold at garden stores or online for approximately $25 for one quart. It can be sprinkled into containers in the nursery or by teaspoon at the root zone during planting. If you do not have access to mycorrhizae, incorporating local topsoils from undisturbed areas may also be effective at establishing the necessary microorganisms. A five-gallon bucket of native topsoil, added by the handful to the root zone at your project site, could do the trick.

If soil amendments are added to increase nutrients, make certain the amendments have been sterilized, otherwise a host of weed seeds may be introduced. The same can be true when using mulch and woodchips. If using native topsoil, select a site with minimal weeds or perform a "grow and kill" cycle (see page 27) prior to spreading the soil at your restoration site.

Plant Installation

Many successful projects let nature do most of the work.

It is not always necessary to install plants at a restoration site. Many successful projects let nature do most of the work. Your job is simply to remove the factors that are preventing recovery from happening naturally; this may be all a system needs to get on the road to recovery. This approach takes time, though, and can be difficult for the public to accept, since a formerly vegetated area will suddenly appear barren for months on end.

Wetlands often have a native seed bank waiting for the space created by the removal of invasives. Otherwise, adjacent sources of native plants may drive recolonization independently. In marsh habitats that require adaptations to saline environments, for example, ROOTS rarely conducts supplemental planting. The natives find their way in once suitable conditions have been established through weeding or other site preparations. However, a cleared site is also open to invasion by non-native seed banks, especially in upland habitat where competition is fierce.

The three methods of planting we will discuss are seeding, installing container plants, and installing cuttings. There are a few key points to keep in mind before charging ahead, though. Every visit to the site is a disturbance, so have a plan of action ahead of time, and be ready to adapt it to changing circumstances, like an unforeseen group of volunteers or a rainstorm. Furthermore, installation may involve potentially destructive activities, like earth-moving. If heavy machinery is necessary to auger holes or install irrigation pipes, try to minimize equipment movement to impact the smallest footprint possible.

When time allows and planting is necessary, install "pioneer species"—plants that naturally reproduce rapidly and extensively—and allow natural succession to facilitate the restoration process. Copy natural patterns of colonization by scattering slower growing, woodier species among blocks of herbaceous pioneer species. Allowing natural succession of a vegetative community may provide more long-term benefits, in that plants that grow naturally in an area can be expected to be hardier than those planted from containers.

Seeding

It is best to distribute seeds in fall, after the first rain. Although lower elevation species can be seeded later, seeds need to germinate and establish roots before the warm weather arrives. Since water triggers germination in most species, try to seed before a predicted rain, during the rain, or immediately afterwards. (Alternatively, give the restoration site a slow, deep soak before dispersing seeds.) First, rake the area to create furrows and then, after scattering the seed, use a lawn roller to press it into the ground. Lawn rollers are available at gardening stores, or you may be able to borrow one for your events. Any heavy drum would work, but at the very least, do the "seed dance," with volunteers stomping over the seeded area with their feet. Mix mycorrhizae into your seed mix to encourage fungus growth. Document the date, species mix, area, and weight of the seed dispersed for future monitoring efforts. In heavily visited areas, you might consider roping the site off from traffic and posting a simple sign explaining your efforts to prevent damage.

For rarer plants, seeding may not be the best method. With a small population, the seed source must be treated carefully and grown in the best possible conditions to promote germination. In these cases, grow the plants in a nursery and later install the plants from containers.

Containers

Plant containers between November and January after the onset of winter rains. Refer to your plant palette and planting plan for direction on spacing and relative abundance for a particular area. Water plants in the nursery the morning of the day they are to be planted. To plant container stock, dig a hole twice as wide and 1½ times as deep as the container itself (for installing narrow pots, see "cuttings" below). This is not always as easy as it sounds—depending on the compaction of your soil, you may need an auger or other digging device (check with local resource agencies for equipment you can borrow). Holes can be dug in advance of the planting day, and should be watered and allowed to drain before installing the plant.

The planting process

(a) Dig a hole twice as wide and 1.5 times as deep as the container itself. (b) Water the hole and let the water drain before planting. (c) When the hole is ready, carefully remove the plant from the pot by holding the plant and soil with one hand and the pot in the other. Then turn the pot upside down and allow the plant to slowly slide out of the pot. (d) The root ball must be buried, and the crown of the plant (where roots join stem) should be approximately two inches above ground level to avoid rot. Lightly compact the backfilled soil to reduce air pockets around the roots. (e) Build a berm around the plant, about two feet in diameter and three inches high. The berm will help to direct water down to the root zone. See Appendix E for a graphic depiction of these steps.

(a)

(b)

(c)

(d)

(e)

A ROOTS captain plants an arroyo willow.

Loosen the plant from its container by massaging the pot and tipping it upside-down into your hand. Shake the plant out rather than pulling it by the stem to avoid damage. Loosen any circling roots but avoid breaking them. If the root is damaged during the process, prune the plant after it is installed to reduce the amount of energy expended on photosynthesis and transpiration. Uniformly mix two cups topsoil harvested from nearby coastal sage scrub habitat into the backfill soil. This topsoil will include the important microorganisms—mycorrhizal fungi—discussed on page 29. (Alternatively, you can sprinkle a teaspoon of mycorrhizal inoculum purchased from a garden store at the root zone.) Dangle the roots of the plant straight down into the hole, and then lightly compact the soil around the plant so there are no air pockets around the roots. The root ball must be buried, and the crown of the plant (where roots join stem) should be approximately two inches above ground level to avoid rot.

The plant is now ready for the most important watering of its life. Build a berm around the plant, about two feet in diameter and three inches high. The berm will help to direct water down to the root zone. Water the plant, and then, after the berm drains, water again until each plant receives approximately three gallons. Top the area inside the berm with mulch to prevent evaporation and weed growth.

Cuttings

Cuttings can be grown in the nursery, in which case install them as you would the larger container pots above. They can also be installed directly into the ground—follow the steps outlined in the "Plant Propagation" section. To install, shove a mattock or narrow shovel's edge into the soil and pull back in order to create space to introduce the plant (this method also works for narrow pots). Once installed, water as you would a container plant. This method is a good way to minimize soil disturbance at your project site.

Watering

Most parts of California face arid climates and scarce water availability, and because of this condition, desiccation (dryness) is the most common cause of revegetation failure. In most of the state, survival will be highest for fall plantings, which allow for root growth throughout the winter in preparation for dry summer heat. However, another possibility to consider is irrigation, not only for plants installed outside the fall or winter window, but also for helping young or fragile

A volunteer carefully waters a native plant in a restoration site. (top) Dri-Water gel paks provide time-released moisture over 2–3 months. (above)

seedlings through their first few years of growth. (Typically, irrigation systems are utilized for two seasons after planting.) There are options to consider that may be more resource effective than installing and maintaining irrigation pipes. ROOTS uses a 500-gallon bladder (available at **www.fol-da-tank.com**) and a volunteer bucket brigade to water plantings during the summer. Alternatively, if the project site is difficult to reach (especially while carrying a heavy water bladder!) you could install DriWater gel paks (available at **http://driwater.com**, approximately $4 for a three-inch tube and gel pak), which provide time-released moisture over two-three months.

In combination with supplemental watering, many plants are able to reach ground water many feet below the surface. To encourage this ability, search out microhabitats for your plants—even a slight depression can function as a water basin for the establishment of natives. Once plants are established, supplemental watering should be terminated. Although extended watering benefits growth, it can also encourage the growth and spread of exotic species.

Monitor and Maintain Success

"There will come a time when you believe everything is finished. That will be the beginning."
—LOUIS L'AMOUR

YOUR RESTORATION PLAN should include sections on monitoring and maintenance. This plan may be an adequate starting point, or you may choose to use this information to develop more detailed monitoring and maintenance plans, ones that can employ volunteers in the effort. The following section can either help you work with your consultant or others in developing these plans, or help you refine and expand what is already in place.

mportance of Monitoring and Maintenance

Monitoring Plan Components

STEP 1: Define goals, objectives, and target criteria.

STEP 2: Choose monitoring parameters, such as percent cover.

STEP 3: Choose monitoring methods, such as line transect.

STEP 4: Determine the duration and frequency of data collection.

A copy of ROOTS' monitoring plan can be found in Appendix G.

It may take a number of years for your restoration site to become self-sustaining. In the interim, the success of your project hinges on your ability to assess your site's progress and to identify and solve problems that arise.

Monitoring will not only allow you to address maintenance needs, such as broken sprinkler heads, weed invasion, and damaged fencing, but will also provide the information needed to demonstrate the success (or failure—often just as important!) of your efforts to funders, stakeholders, and the public. Often, project sponsors will require monitoring as a condition of current and future funding.

Restoration deals with constantly and unpredictably changing, dynamic systems, which necessitates fine-tuning and perpetual adjustment, or adaptive management—using the results of monitoring and evaluation to inform future plans and approaches. Information on the techniques and effectiveness of your efforts should be made available to others interested in carrying out restoration work. Restoration is a relatively new science, and techniques are still evolving. While there is always a risk of failure at individual project sites, thorough documentation and reporting can result in future success and an expansion of the field's knowledge base.

"The important thing is to know what you don't know." —MARGARET MEAD

Monitoring data should be evaluated and used as a check on progress towards the goals and objectives in your Project Plan. However, you may find that your project is progressing toward a system that has highly desirable functions apart from the original goals. In this case, determine whether to modify the goals or to attempt re-installation. Set reasonable expectations with the Advisory Team and with your volunteers from the beginning, and always remember that failure is subjective, especially where natural systems are concerned.

Monitoring Techniques

One of the most common and easiest forms of monitoring is a "before and after" comparison in which you compare photos of the project site from before the first restoration efforts to subsequent photos taken along the way. While this can be an effective way of showing change over time, you really need to compare your site to reference sites, or another natural model that is experiencing the same weather over the same time period, in order to judge actual success. It is good to have one reference site that represents the base-line conditions of your target area; it is better to have a reference site that performs the functions addressed in your goals. The reference sites should be monitored at the same time as your project site. By using a reference site, you eliminate variables affecting the site progress, such as drought years, and you are able to truly compare success criteria such as growth rate and sustainability.

You can choose from among many different parameters and methods to conduct monitoring. Parameters should be selected to be sensi-

Initial photos of a restoration site will provide visual baseline data of the site's condition. This site was covered by an invasive plant—black mustard (Brassica nigra) *(left). A subsequent photo of the same site shows evidence of the restoration site's progress (right).*

Ewel's Success Criteria

J.J. Ewel defined properties that are largely unique to healthy, functional ecosystems, and may be used to judge the success of habitat restoration.

- **Sustainability**
  The vegetation should maintain and replace itself without inputs such as water and fertilizer.
- **Resistance to invasion**
  The target area should have low invasibility; resisting non-native, weedy species intrusion.
- **Nutrient retention**
  Undisturbed, native habitats should recycle nutrients internally, with little loss from the ecosystem.
- **Productivity**
  Reproduction and decomposition rates should be similar to the reference habitat.
- **Biotic interactions**
  The whole range of species in a community should be present. These include mycorrhizae and pollinators.

tive enough to detect change and be measurable, and in order to do so, you should first know what questions you want the data to answer. Common measurements include: percent survival, percent cover, species presence, or species diversity (an explanation of each of these parameters is below). Your objectives and target criteria should provide a good idea of what parameters to seek out. Ask yourself "will the data provide an indication of the restoration performance?" and "will this sampling method help us answer our questions?" The challenge is to design the monitoring plan in a way that balances resources (such as cost, time, staff, and equipment availability) with accurate information gathering so that the end product will provide a rationale for decision-making and an ability to judge success.

Common Monitoring Parameters

Quantitative data, such as percent survival and percent vegetative cover, provide measurable accounts of site progression. These measurements are often required for the agencies on whose land you may be working, or even by funders. At Upper Newport Bay, we calculate the percent survival by species, in order to determine which species should be used at other sites, as well as overall survival of the plant palette. We also calculate percent cover of natives, non-natives, and bare ground.

Another common and useful variable is diversity of native and invasive flora. Biological diversity refers to the number of species in an area and includes a measure of the variety of species and their relative abundance. For example, a disturbed site covered in ice plant has lower diversity than a restored site with three or four dominant species. Ecologists agree that higher diversity not only provides more habitats for different animals, but also is more resilient to disturbances such as drought or flood. Comparison of diversity subsets, such as native species, invasive species, rare species, etc., may be more meaningful than a measure of overall diversity, which does not provide information about the occurrence of specific elements. A variety of diversity indices exist as indicators of ecosystem health, the most common being the Shannon-Weiner diversity index.

Diversity patterns vary by location, and smaller areas typically exhibit less diversity than large areas. Determining the number of species present in a community is best accomplished by several monitoring events during different seasons because there can be great variation over short periods. However, if resources are limited, the best time to conduct monitoring is after the growing season—typically late May or

early June. Be sure to conduct your monitoring at the same time each year, however. A credible assessment of diversity over time has to compare datasets taken during the same season.

Monitoring Methods

No matter what type of monitoring being performed, always bring a notepad and a camera in order to document what you find. Qualitative assessments, including vegetation establishment, mortality, species composition, non-native plant invasion, and irrigation and maintenance needs are simple data points that do not require much time or effort to gather. It is a good idea to establish permanent photo points to document vegetation development. Hammer a wooden post into the same corner of each site with an identifying label (i.e. "Site A1") to help catalogue photos. You will accumulate photos quickly, so to help keep them in order, try to always keep the site label in the photo, and organize them by date. This log of qualitative observations chronicles your project and can provide information to interested parties.

Quantifiable data, gained through more detailed and systematic monitoring, is more complicated and therefore needs a documented protocol and a quality assurance program that may involve hiring technical experts or training volunteer monitors. There are two common techniques used to quantify vegetated plots: line transects, in which a straight line is drawn across a plot and every plant that comes in contact with that line is surveyed (100-meter fiberglass tapes are available at hardware stores), and quadrats, squares (often one meter on a side) built from piping or similar material, in which every plant within the quadrat is surveyed. Random placement of transects and quadrats will allow for unbiased sampling. Monitoring methods and frequency will doubtlessly be limited by time and money. One way to overcome this obstacle is to sample small zones (sub-samples) within the project site in detail and then extrapolate results to the whole area. The statistical significance called for in your protocol will dictate the number of sub-samples required for quality assurance. You can evaluate the accuracy of your method by comparing a thorough sampling protocol with sub-sampling methods. For example, count every stem in a 50-meter square area and then conduct stem counts in increasing numbers of quadrats within that 50-meter square area until extrapolated sub-sample results reflect the whole area to a level with which you are confident.

Common parameters to be measured during monitoring include (more complete explanations and measurement methods can be found in Appendix F):

- **Percent Survival:** Measuring for percent survival among the installed native plants will give a quick indicator of the growing success within the project. By cross-referencing the survival data by species, you will have a closer look at what works best in a given site for future plantings.
- **Percent Cover:** Measuring percent plant cover at a restoration site can give good information as to the maturity of the plants on site (more coverage will mean older plants) and may also indicate the site's development as a viable habitat (mature native plants versus relatively few non-native plants). Using a transect and quadrats, data can be collected to determine overall plant coverage, native plant coverage, non-native plant coverage, and the presence of bare ground. By comparing to your reference site, you can measure over time the development of the restoration site into a viable habitat.
- **Species Presence:** It will be important to note the species present in the restoration site over the course of the project. Seeing how the particular native and non-native plant species spread throughout the site will offer insight into the nature of the site itself, and through analysis of the data, you will be able to adjust future restoration plans in that site accordingly. These measurements should also include wildlife species. By collecting data about wildlife present (either passing through or making a home) in the site, you can determine the health and development of the site as a viable habitat.

A volunteer monitor uses a line transect (left). Volunteer monitors use a quadrat (right).

- **Species Diversity:** Native species diversity is also a great indicator of the ecological health of a restoration site. It is not the number of plant and animal species alone that indicates greater diversity; you must also take into account the relative abundance of the species present. If there are 100 individuals of 10 species different species, but 90 of the individuals are the same species (and one each of the other 9 species) this is a low diversity site. Compare this to another site that has 100 individuals of 10 species, and each species has 10 individuals—this site shows high diversity. Again, by comparing plant and wildlife diversity in a reference site to that in your restoration site, you should be able to determine the health of your site using species diversity as an indicator.

Monitoring results can be provided in regular reports to stakeholders, your Advisory Team, sponsors, and other project managers. Summarize and graph results in an annual report including general sections: summary, introduction, site description, methods, results, discussion, conclusion, recommendations, acknowledgements, and literature cited.

To facilitate analysis and presentation of results, design a database so that you can easily create the desired graphs such as Plant Survival over Time, and Diversity by Site. For example, a spreadsheet program will allow you to catalog Percent Survival. Create columns for Species Name, Number Alive, and Date Sampled. Name separate pages for each restored plot (and reference plots) within the same Percent Survival worksheet. This data can quickly be manipulated to produce a bar-graph of each plot illustrating which species had the best survival rates.

Experimentation

Scientific experimentation can help you gather important information on what is working best in your restoration program.

Scientific experimentation can be a valuable tool in choosing effective restoration strategies, and can reduce resources invested in strategies that do not work. We recommend that you record data on variables such as watering and weeding regimes, container size, seed origin, etc. and use monitoring data to answer specific questions. Keep it simple by asking a question about one variable at a time. Examples include: Percent Survival of Sagebrush vs. Bladderpod, Percent Survival of Sagebrush Planted in Four-Inch Liners vs. One-Gallon Pots, Percent Survival of Sagebrush with Mycorrhizal Inoculant vs. Without, Percent Cover of Sagebrush vs. Presence of Belding Savannah Sparrows. As you gather more information and reflect on your program objectives, you will find more and more questions about the local habitat that can be answered thanks to your restoration efforts.

Timing

Thirty years into a prairie restoration project, Aldo Leopold—father of the restoration movement and author of A Sand County Almanac*—was asked whether it was successful. Leopold replied, "give it another thousand years."*

Monitoring work, just like your restoration work, should have a timeline that includes before, during, and after information. The data gathered in the "before" stage will be the baseline, or starting point, for measuring and comparing change as the project progresses. Baseline data will provide pre-restoration conditions against which target criteria can be compared, so collect this information before project implementation. Initial data to collect may include non-native vs. native species, percent cover, presence of animals, presence of indicator species, and dominant species.

Keep a restoration log book. Immediately after any restoration work at the project site, document what was done. How many plants were installed? How much water did they receive? What area was seeded? Also remark on what worked well and what should be done differently, such as the number of volunteers and leaders, interpretive displays, or range of physical activities, as well as any comments from your volunteers. This information will help each subsequent event to run more smoothly, and will help you keep your workforce happy.

Plan to maintain the site and make regular monitoring visits (weekly) to track invasion and plant growth. Optimally, plants should be monitored both before and after the growing season. To save time and money ROOTS monitors vegetation in May or June, when the rain stops and the temperature begins to climb. Animals should be monitored during peak abundance, usually during the breeding season in May; however, if birds are an important element of your goals, monitor during the migration season as well, in January.

As the site matures, it should become less vulnerable to disturbances such as invasion or desiccation. Since restoration sites become stable with age, the frequency of data collection can decrease over time, as well.

As the restoration site matures, it should become less vulnerable to disturbances such as invasion or desiccation. Since restoration sites become stable with age, the frequency of data collection can decrease over time, as well. A typical timeline for plant coverage monitoring is annually in spring for the first three years, and at intervals of two to five years afterwards until the system is self-maintaining. For quantitative data sets such as percent cover that are affected by the size of plants, wait until the site has stabilized before documenting the conditions—this should take about one month.

The monitoring should continue until your goals are attained, or until the Advisory Team agrees that the criteria cannot be met. This may take a while—restoration projects may take decades to reach goal conditions. (As we mentioned, this is a commitment!) However, after two years, most restoration managers expect at least 50 percent of the installed plants to be

healthy. If you calculate a survival rate lower than 50 percent, re-evaluate your methods and the site conditions, and consider replanting.

Water Quality Monitoring

Water quality monitoring can be a useful tool to add to efforts in habitat restoration. Native habitat is generally considered an effective means of trapping and filtering pollution that might otherwise end up in waterways. Measurements taken before, during, and after your restoration project can therefore provide a sense of whether your efforts are affecting water quality. As always, however, time and resources must be measured against the value of the information you are gathering. There may be other groups or agencies working in the area who can conduct water quality testing for you. Seek out what information is readily available before you take on yet another aspect of what has already become a multi-faceted program.

Water quality monitoring is beyond the scope of this guide; however, the EPA provides volunteer water-quality monitoring manuals for streams, lakes, and estuaries through the National Estuary Program. See the website **www.epa.gov/owow** for educational resources and funding. You can also contact the State Water Resources Control Board at **www.swrcb.ca.gov/nps/volunteer.html** for information about existing water quality programs in your area.

Management and Maintenance Issues

This section discusses two common maintenance problems and how to tackle them. Irrigation is another maintenance issue, and is addressed on page 32 above.

Weed Management

Weeding is likely to be an ongoing management task. Even the best site preparation efforts will not eliminate the need for some weeding after the native plants are in place. Once your native plants are established, they will help shade out undesirable exotic species and frequent weeding will not be necessary.

It may be useful to develop goals with respect to weed management. Possible goals include:

1. Weed cover is managed to levels below those found in reference wetlands, and

Volunteers remove weeds in a restoration site.

2. Weeds do not adversely impact the functioning of the restoration, e.g., by displacing native plants.

Just as with exotic removal for site preparation, volunteer events can help with ongoing weed management. However, for this purpose, it may work best to use seasoned, well-trained volunteers who are able to identify the weeds from the natives. It is also a good idea to mark the native plants with small flags.

Replanting

While some plant loss is natural, if you have very high plant mortality at your site (e.g., greater than 50 percent), you should evaluate the reason for the mortality, and the likelihood that it would recur if you replant. Replanting may make sense if the plant loss was caused by something that is unlikely to recur, like an extreme weather event. Common causes of plant loss that can be remediated include:

- Planting species in the wrong microhabitat (e.g., high marsh species in low marsh elevations);
- Poor planting methods (e.g., weak plants, inadequate irrigation, incorrect spacing of plants); or
- Failure to protect sensitive transplants from herbivores or human trampling (e.g., through fencing or small cages around individual plants).

A small investment in experiments can help shed light on how to replant in a way to maximize success.

Engage Your Community

Volunteer-based Projects

The greatest value of restoration may be its ability to transform, through education and inspiration, the human beings who inhabit and shape the land.

Volunteers Can Help With:

- **Plant propagation**— work in a native plant nursery *(see page 19)*
- **Site preparation**— exotic plant removal, etc. *(see page 27)*
- **Plant salvage events** *(see page 25)*
- **Plant installation** *(see page 29)*
- **Monitoring and maintenance activities** *(see page 35).*

THE GREATEST VALUE of restoration may not be its ability to transform the landscape, but rather its ability to transform, through education and inspiration, the human beings who inhabit and shape the land. Every volunteer-based restoration project needs a qualified workforce; luckily, every community already has one. The residents of California are incredible volunteers, annually dedicating thousands upon thousands of hours to efforts to help their neighbors and their community. Your job will be to tap into this network, and offer these volunteers a fulfilling experience that will keep them returning for more. Your efforts to this point—educating yourself about your project area, planning your project, preparing the site and the plants, etc.—have all been preparation for spreading this knowledge to your community. In this section, we will discuss how to gain the support of volunteers to help you achieve the goals of your project.

In addition to providing the person-power necessary to make your project happen, volunteers add economic value to your project, which can be useful when showing matching funds to potential funders. According to the Independent Sector (2005), volunteer labor is valued at $18.04 per hour. A three-hour event with fifty volunteers is valued at $2,706! They are not without costs, however. At times, you will need to provide transportation, meals, insurance, and training, each carrying a price that must be met by the project budget.

As we have mentioned previously, not all activities are appropriate for volunteers. Certain activities, such as application of herbicides or use of heavy equipment, should be left to those better trained and suited for such work. In most instances, the staff at local resource agencies can fill

this role. Otherwise, you might seek the support of the California Conservation Corps, which can bring crews of 10-15 young men and women trained in the safe use of tools and directed by a supervisor, to the site to help. For more information, visit the website **www.ccc.ca.gov**.

Conducting Outreach

To develop a good group of volunteers to work on restoration, you have to first let them know that your project exists, and that you could use their help. There are many ways to do this: some of the most effective are outreach to the media and the community, and holding volunteer events. Prepare an outreach plan to help guide and provide consistency to your efforts. The following section addresses some of the most effective ways to conduct outreach.

U.S. EPA has an excellent resource, Getting In Step: A Guide for Conducting Watershed Outreach Campaigns, a companion to the stakeholder guide referenced in the Digging In section, available for download at **www.epa.gov/owow/watershed/outreach/documents.** This guidebook can help you develop a plan to address public perceptions, promote activities, and inform stakeholders.

Media coverage

Once you have developed your outreach plan and gotten buy-in from your Advisory Team, it can be helpful to inform the local media of your new restoration efforts. Public response to publicity may alert you to issues you had not considered and build volunteer support.

One of the easiest ways to draw media attention is to write and distribute press releases and media advisories about upcoming events. Media advisories should be sent out a week or so before the event (and sometimes again the day before), and follow a simple format: **What** is happening; **When** it is happening; **Where** it is happening; **Who** is doing it. A press release is usually sent out a few days before the event, and provides a more detailed account of what will transpire and why your group will undertake the activity. You can also send out press releases about your program when something noteworthy happens, such as hiring a new staff person or discovering the presence of a rare or endangered species in one of your restoration plots. Press releases follow a simple format, with the most important information at the beginning and supporting information following, allowing an editor or reporter to see all the pertinent facts at first glance. Include background on your program, quotes from notable community leaders about the need the program fills, and of course, your contact information.

You should fax or e-mail your media advisory or press release to the specific department that will be most interested in your efforts—typically the "Local" or "Community" section—and find out who the local environmental beat reporters are so that you can fax them a copy, as well. Also, send a media advisory to the editor of the calendar section (if different from the Local or Community editor). Keep your media lists as up-to-date as

possible, and in a form that is easy for anyone (e.g., an intern or volunteer) to use. Follow-up with a courtesy phone call to ensure the press release or advisory was received and to offer answers any questions. Ask whether a reporter will be coming out to cover the event. Offer to provide photos. Over time, try to get to know the reporters who might cover your events.

Local papers are an excellent venue to publicize your events and report your success, but do not forget about local television, radio stations, and web sites, either. Try to use as many forms of media as possible to help spread word of your efforts. The media should be seen as your partners, helping to inform the community about your efforts, so always be prepared to speak with a reporter about the project's history, goals, and positive benefits to the environment and the community.

Community support

To develop community support, the community has to know who you are. Undertake an effort to distribute as much information about the program as possible. Media outreach is one way, but many of ROOTS' volunteers learn of the program from simple flyers posted around Upper Newport Bay. At each restoration site, maintain a basic outreach station, which may simply be a laminated flyer stapled to a wooden stake. More elaborate stations might include plant identification photographs, a frame built from invasive plants, or a list of the names of volunteers who have participated in the restoration of the site (a great way to say "thank you" to volunteers, as well). When working in the field, bring along flyers and be ready to answer the inevitable questions from passersby. Try to post flyers at libraries, grocery stores, coffee shops, campuses, and any other gathering place.

An outreach program could include presentations to groups that have similar interests, such as the Audubon Society, the California Native Plant Society and the U.C. Cooperative Extension Master Gardeners for your county. Your project plans, reasons for undertaking the effort, and pictures of the site will make a great story to share with these groups. In addition to providing knowledgeable volunteers, they may be able to help with publicity—send all press releases and advisories to the editors of these groups' newsletters, and ask that they be distributed to the groups' e-mail networks, as well. For more professional support, consider hosting a workshop on some aspect of restoration that you would feel comfortable teaching. The native plant propagation workshops that ROOTS hosted attracted experienced restoration managers and horticulturalists and helped strengthen our image among the professional community, and by extension, with the public.

The homeowners associations in the neighborhoods surrounding your restoration site(s) can be a great source of support as well. Not only do

Incentives for Community Involvement

- Control erosion and reduce flood damage
- Enhance the neighborhood and create a sense of community
- Attract tourism
- Preserve history and cultures
- Increase fishing opportunities
- Create jobs and educational opportunities
- Create trails and greenways
- Reclaim ecological values
- Restore water quality
- Meet like-minded community members and have fun!

these associations publish newsletters and maintain mailing lists that can publicize your program, but they can also help educate their homeowners about the impact that landscaping decisions can have on the environment. Even without homeowner association participation, try to involve neighbors in your project as much as possible. It is important that community members understand why your program is removing trees and plants (which they may value aesthetically) from their neighborhood, and why native plant establishment is important for the health of the ecosystem.

Another source of community support could be local colleges and universities, which may offer courses in ecological restoration or natural history, and could be excellent sources for student volunteers or interns. The professors of these courses are good resources to cultivate, both for their knowledge of the field and their ability to encourage students to volunteer with your program. Many universities and high schools require students to complete hours of community service or an internship, so consider offering an internship or two. In the UC system, this type of internship is referred to as Independent Study, and students typically intern ten hours per week for the ten-week quarter. College interns can undertake a wide variety of projects to help your project meet its goals. ROOTS has had interns work on outreach and publicity, graphic design, volunteer management, water quality monitoring, and plant propagation, among other projects.

Many universities and high schools require students to complete hours of community service or an internship, so consider offering an internship or two.

Internet Recruitment Resources

There are a number of sites on the internet than can help get the word out to potential volunteers; most of the sites offer their service for free. Here is a sampling: Craigslist, Idealist.org, Volunteer Match, One Brick, Volunteer.org, Dosomething.org, Networkforgood.org.

Roots volunteers offer information and native plants at an Earth Day festival.

Events

Participating in environmental fairs and other events, such as Earth Day (April 22) or Coastal Cleanup Day (third Saturday in September) is an excellent way to reach a whole new group of community members who may not be familiar with your program. Your booth or table should include information on how to get involved and resources that demonstrate the value of the project. At Upper Newport Bay, the non-profit group Newport Bay Naturalists and Friends host three annual events with informative, activity-oriented booths, music, lunch, and lectures. As a result of our partnership with the Newport Bay Naturalists and Friends, ROOTS sponsors a booth and serves as a featured speaker at these events. Our booth includes a photo album that shows volunteers in action (demonstrating

how much fun our projects are), and how the restoration sites change over time. We sell native plants that we have propagated, and provide snacks made from native plants, such as "lemonade" (made from the native lemonade berry) and acorn bread.

These general events that reach out to the entire community are important; perhaps just as important, though, are the smaller events that you plan specifically for your volunteers to show your appreciation. We have planned any number of these, from canoe or electric boat tours of Upper Newport Bay, to organized walks through native habitat led by a resident plant or wildlife expert, to picnics or annual dinners with mini-award ceremonies for special volunteers. Whatever method you choose, finding little ways to honor your volunteers and show how grateful you are for their efforts can help you forge a lasting bond with these co-workers that will keep all of you refreshed and coming back for more.

Working with Volunteers

One of the most rewarding aspects of community-based restoration is the opportunity to work with like-minded people towards a common goal. Working with volunteers creates a special set of circumstances that you must be aware of, however. First and foremost, you have to keep in mind that volunteers are not your employees! They are working with you to fulfill their own desires. Your job should be to help them achieve these dreams while keeping them on track towards meeting your overall project goals. Not always an easy task, but here are some tips that we have found to help:

Volunteers are not your employees! They are working with you to fulfill their own desires.

- **Plan for your volunteers.** On page 26 we describe some ideas on how to prepare for site restoration events so that the disturbance to existing habitat is limited. In addition to minimizing site disturbance, a well-run, thoughtfully-planned event will help keep volunteers motivated and coming back. It all comes down to advance planning—thinking through the activity for that volunteer event and what will be needed to make it an enjoyable, safe, and productive experience.
- **Plan activities for all age levels and physical abilities, and be prepared to tailor your event to your volunteers.** For example, put a group of college students to work carrying water and digging holes, more strenuous activities better suited to strong muscles and young bones. Or stake out a section of non-natives and encourage children and older volunteers to pull weeds while sitting down. Weekend events will attract a larger and hardier crowd than weekdays, so save

your heavy lifting and digging for the weekends. Weekday events, on the other hand, will most likely draw more retirees, some of whom will regularly devote hours to volunteer work. ROOTS' weekly "Stewards Day," held every Wednesday morning, takes place at our nursery, where volunteers primarily focus on plant propagation. Other less strenuous activities include seed collection, seedling transplanting, and watering by hose.

- **Create a comfortable, enjoyable place for volunteers to work.** Most volunteers will probably be attracted by the natural landscape in which your project is situated. However, you will still need to provide an appealing place for volunteers to gather, socialize, and work. One of ROOTS' first projects was to build a shade house in front of our nursery from *Arundo* stakes. This not only creates extra space in which to grow plants, but also provides an attractive, cool spot for volunteers to work and chat. Try to keep gathering places clean, and make sure there is a clean toilet available.

All the flowers of all the tomorrows are in the seeds of today.

—CHINESE PROVERB

- **Provide food!** Food, snacks, cold drinks, and popsicles are always welcome, and with enough lead time, you should be able to get ample donations to satisfy any size group. Check with local shops, from the hardware stores to the local movie theater. Most bakeries and coffee shops throw away that day's pastries at the close of business, while grocery stores and restaurants often have a budget to support community efforts. In fact, the more you ask, you will find that many local businesses will want to help. Call or drop by and speak with the store manager or donations department (a sample donation request letter is in Appendix G).
- **Schedule breaks from work.** Once you have gotten all this food and drink, give your volunteers the chance to snack. During events, encourage volunteers to take a break and meet one another. Try to schedule a "half-time," and provide a shade canopy or large umbrella to help volunteers cool off. This break is also a good opportunity to share stories about the history of the site or other interesting information about what makes the habitat you are restoring so special.

Upper Newport Bay project volunteers relax on a pile of invasive ice plant after they pulled it from the upper marsh.

- **Assign Leaders.** It will be important for you to develop a cadre of trustworthy, experienced volunteer leaders to help you oversee larger restoration events. We call our leaders "ROOTS Captains" and meet with them thirty minutes before the event to set goals and go over safety issues. We also reward our

leaders—third-time returning volunteers receive a prize, like a shirt or poster. You may choose to develop a formal training program, like the ten-week Naturalist Training organized by the Newport Bay Naturalists and Friends. Trained Naturalists are able to field questions about the history and ecology of the Bay, making them excellent volunteer leaders and great spokespeople for reporters.

Risk Management

Another important aspect of working with volunteers is assuring their safety. Restoration volunteers often work long hours outdoors with heavy equipment—they are prone to injury! Take a few minutes at the start of each restoration event to go over safety issues (including the proper way to lift—bend at the knees!) and urging your volunteers to watch out for one another. Our volunteers need to sign a release of liability from the landowner and the lead organization at each event (see sample in Appendix H). Repeat volunteers need only sign in to confirm that they have previously read the liability waiver. The sign-in sheet also serves as a basis for a mailing and e-mail list, and feedback about how the volunteer heard of the project.

Common maladies include dehydration, sunburn, allergies, and rashes. We recommend that you (and someone else on your team who can be at restoration work days that you cannot attend) take a basic first aid course, widely available from the Red Cross, to be prepared to treat these symptoms. Bring a first aid kit to each event that includes plenty of water, sunscreen, antihistamine medication, and hydrocortisone cream. Your leaders should know where the first aid kit is located at every event.

Education

It is important to include some form of public education in your efforts. Not only will this empower your volunteers with the concepts underpinning their efforts, but it will help ensure that the community understands and values the project, creating the public will and political backing to protect the area over the long-term.

Your efforts to restore a habitat can be an educational resource for the entire community.

Your efforts to restore a habitat can be an educational resource for the entire community, an aspect of the program that may surface in your outreach and publicity efforts. For example, your contacts with the media may prompt reporters to develop more in-depth stories about your project and about habitat restoration in general. When leading volunteer events, make sure volunteers know why you care, and why their actions matter to the wildlife. Prepare a quick lesson to share during a break to teach your volunteers about ecology, water quality, native plants, diversity, cultural resources, or whatever you want them to take home and share with their friends and family.

Another way to incorporate education is to work with teachers to bring their students out for field trips. You can offer to visit the classroom in advance to help prepare the students. Plan a 45-minute presentation, and include visuals and time for questions and answers. When the students arrive at your site, be prepared with planned activities and some informal lessons.

You could also offer a more formal K–12 program by preparing a curriculum. Many teachers are hungry for quality science curricula rooted in hands-on experience that will help them teach difficult subjects like biology and chemistry. To maximize their usefulness in today's educational environment, lesson plans should be aligned with California state content standards. For ROOTS, providing an opportunity for formal, in-class education about wetlands ecology and native habitat was a goal from the start, so we hired an educational consultant to adapt and create lesson plans specific to Upper Newport Bay that met State science standards. The resulting high school curriculum is called *Our Wetlands, Our World* and is available free of charge on the California Coastal Commission web site at **www.coast4u.org**. The curriculum can be easily adapted to other California wetlands. It encourages field trips to Upper Newport Bay (or another wetland) and has helped more students participate in our restoration events. ROOTS also provides bus scholarships for underserved schools.

Bringing youth to the restoration site is important on many levels. As urban growth consumes more and more of California, and as children's lives become increasingly scheduled with less freedom to explore, many are growing up feeling disconnected from nature. In his book *Last Child in the Woods,* Richard Louv calls this phenomenon "nature deficit disorder." When nature is an abstraction, it is unlikely that a child is going to grow up caring about what happens to the few remaining wild places. Giving students (and other volunteers) the opportunity to experience nature, and even to heal it, contributes to the bonds that are essential for the long-term protection of the natural world.

Share Your Results

CONGRATULATIONS! By now, you are well on your way to a successful community-based habitat restoration program, and are part of a growing movement that is changing our relationship to the wild places near us. In addition to enhancing and expanding habitat, the community-based restoration field is helping to build a larger constituency in support of changing the way we protect, manage, and restore our few remaining coastal wetlands.

There is even more you can do to further this cause. Ecological habitat restoration is a relatively new and evolving field. Using volunteers to conduct this work is an even newer proposition. There is much to be gained by sharing your experience and learning from the experiences of others. You may have pioneered new techniques, or discovered new information about a specific ecosystem. Or you may meet other practitioners in the field who are facing similar challenges, and you can join forces to develop methods for overcoming these obstacles. If nothing else, you will make yourself part of a larger community that shares a similar vision.

There are many ways to join the restoration community. You can participate in conferences sponsored by professional associations, like the Society for Ecological Restoration. You can seek out similar organizations in your region—many of these groups are listed in the Coastal Commission's on-line Resource Directory. Or you can participate in one of the free workshops on this Guide that the Coastal Commission sponsors. For both the Resource Directory and a list of workshop dates and locations, please visit our website at **www.coast4u.org**.

However you participate, you are contributing to a field that provides a meaningful way for Californians to create a physical and emotional link to the very ground upon which we live. On behalf of the Coastal Commission's Community-Based Restoration Education Program, thank you for dedicating your time, energy, and passion to restoring our shared heritage.

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California Department of Fish and Game Natural Diversity Database, http://www.dfg.ca.gov/bdb/html/cnddb.html

California State Board of Education Content Standards, http://www.cde.ca.gov/be/st/ss/index.asp

California Wetlands Information System, www.ceres.ca.gov/wetlands

DriWater, Time-Release Water, http://driwater.com.

EPA Grant-Writing Tutorial Software, http://www.purdue.edu/envirososft/grants.html

FOL-DA-TANK, portable water tanks, www.fol-da-tank.com

Soil Testing Labs in California, http://ceventura.ucdavis.edu/ben/avo_handbook/resources/labs.htm

U.S. EPA Wetlands, Oceans & Watersheds, www.epa.gov/owow

Volunteer Recruitment

Craigslist, www.craigslist.org
Idealist, www.idealist.org
One Brick, www.onebrick.org
Volunteer Match, www.volunteermatch.org

Organizations

Audubon Society, www.audubon.org
California Conservation Corps, www.ccc.ca.gov
California Invasive Plant Council, www.cal-ipc.org
California Native Plant Society, www.cnps.org
San Francisco Bay Joint Venture, www.sfbjv.org
Society for Ecological Restoration, www.ser.org
Southern California Wetlands Recovery Project, www.scwrp.org
University of California Cooperative Extension Master Gardeners, www.mastergardeners.org
Upper Newport Bay Naturalists & Friends, www.newportbay.org

APPENDIX A

Sample Kick-off Meeting Agenda

Orange County Coastal Restoration and Education Project Meeting

Thursday, January 25, 11:30 am – 1:15 pm

Shellmaker Island, Upper Newport Bay

A G E N D A

I. Introductions (10 minutes)
   - (What is your relationship to Upper Newport Bay?)

II. Discussion of Needs (20 minutes)
   - What are the greatest needs in Orange County in terms of coastal/wetlands education and public involvement opportunities?

III. Examples of Relevant Ongoing Projects (15 minutes)
   - Bolsa Chica Conservancy
   - Audubon

IV. Presentation (15 minutes)
   - The California Coastal Commission's proposed Coastal Restoration and Education Project

V. Discussion of Proposed Project (45 minutes)
   - Does the project address the needs brought up?
   - Are there other current programs in the area and elsewhere that we can link to or learn from?
   - Are there any other resources to take advantage of that have not discussed?

VI. Next Steps

VI. Adjourn

The Department of Fish and Game's facility on Shellmaker Island is on Shellmaker Road, off of Back Bay Drive. Back Bay Drive is off Jamboree Blvd. For a map and more detailed directions, please go to: www.newportbay.org/map.html

APPENDIX B

ROOTS Restoration Plan

FINAL
UPPER NEWPORT BAY
RESTORATION EDUCATION PROJECT
COASTAL SAGE SCRUB AND RIPARIAN
RESTORATION PLANS
FOR THREE SELECT SITES

H. T. HARVEY & ASSOCIATES
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ECOLOGICAL CONSULTANTS

FINAL
UPPER NEWPORT BAY RESTORATION EDUCATION PROJECT COASTAL SAGE SCRUB AND RIPARIAN RESTORATION PLANS FOR THREE SELECT SITES

Prepared by:

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Project #: 2174-01

December 30, 2002

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INTRODUCTION

Newport Bay is a coastal estuary located in Orange County, California (Figure 1). The mouth of Newport Bay is in the city of Newport Beach and the Bay extends inland for approximately 6 miles. The California Coastal Commission's Restoration/Education Project area is located in Upper Newport Bay (UNB). UNB extends from the Pacific Coast Highway (State Route 1) Bridge up to the Jamboree Road Bridge.

Upper Newport Bay is fringed with tidal salt marsh that historically would have been surrounded with a mixture of coastal sage scrub (soft chaparral) and grasslands. In addition, a diverse marsh assemblage of high salt marsh and coastal sage scrub species would have occurred historically in the transition zone (ecotone) between these wetland and upland habitats. However, extensive development has encroached upon UNB such that little of these ecotonal and upland habitats remain today. Moreover, much of the undeveloped upland habitat bordering the salt marshes of UNB has been disturbed by human activities and is dominated by ruderal species, such as field mustard (*Brassica rapa*), and invasive species, such as lollypop tree (*Myoporum laetum*). Restoration of the salt marsh/upland ecotone and the coastal sage scrub on the surrounding uplands is both feasible for volunteer groups and would provide significant biological benefits to the UNB ecosystem. Marsh/upland ecotone and coastal sage scrub restoration is feasible for volunteer groups because these areas are easily accessible and can be restored with manual revegetation techniques. In contrast, salt marsh habitat restoration often involves excavation with heavy equipment to restore tidal hydrology and elevations suitable for salt marsh vegetation establishment. Therefore, in collaboration with Kristina Finstad of the California Coastal Commission, we decided to focus this document upon coastal sage scrub restoration.

In some specific locations, topography and anthropogenic influence has created concentrated freshwater runoff that supports riparian plant species including willow (*salix* ssp.). During field reconnaissance, we identified two locations suitable for restoration of willow-dominated riparian habitat. Therefore, the restoration of Willow Riparian Habitat is also addressed below.

Finally, there are several invasive non-native species currently occupying the disturbed areas around UNB. These include: giant reed (*Arundo donax*), myoporum, (*Myoporum* sp.), pampas grass (*Pampas* sp.), sea or hottentot fig (*Carpobrotus* sp.), and field mustard. These species will need to be eliminated in order to improve the success and limit the long-term maintenance costs of a successful restoration effort.

The techniques for restoration of coastal sage scrub, like most types of restoration, is currently being refined. Current research generally focuses upon propagation, irrigation, and long-term maintenance. Although significant improvements in the success of direct seeding have been achieved, the restoration plans presented below rely upon plantings from container stock to improve success. Some direct seeding of grasses and forbs will be used to prepare the soils for coastal sage scrub, inhibit invasive non-natives, and increase plant community diversity. The coastal sage scrub planting will require temporary irrigation during the plant establishment period. Generally, irrigation is one of the most important, expensive, and laborious aspects of a revegetation project. Therefore, below we provide a design for a coastal sage scrub revegetation

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Upper Newport Bay Restoration Education Project: Site / Vicinity Map

File No. 2174-01	Date 11/8/02	Figure 1

experiment to test the effectiveness of three different irrigation techniques. This experiment can serve as an education showpiece for Interpretive Center (IC) visitors and the results can be used to guide the irrigation design for future projects.

This report is divided into four sections (Figure 2): (1) a coastal sage scrub restoration experiment along Barranca I at the IC, (2) a riparian restoration experiment on the hillslope below the IC and along Santa Isabel Channel after it daylights from Irvine Avenue, (3) a restoration project in the Bayview site, and (4) procedures for eradication of invasive species encountered at these sites. The format was chosen to limit repetition within the document. Where necessary, references are made to previous sections of the document where the appropriate methods can be found.

Appendix C presents an annual schedule for implementation of the various restoration tasks described in this plan for coastal sage scrub, high salt marsh and riparian habitat restoration.

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Upper Newport Bay Restoration Education Project: Restoration Site Locations

File No. **2174-01**	Date **12/27/02**	Figure **2**

DESIGN RATIONALE AND OBJECTIVES

The coastal sage scrub restoration experiment proposed below has the following objectives:

1) compare the effectiveness of three different irrigation techniques on the survival and growth rate of four of the dominant coastal sage scrub species;
2) begin the restoration of coastal sage scrub habitat in the area between the IC and the Delhi Channel, and;
3) create a restoration demonstration site/exhibit for the IC docents to share with the public.

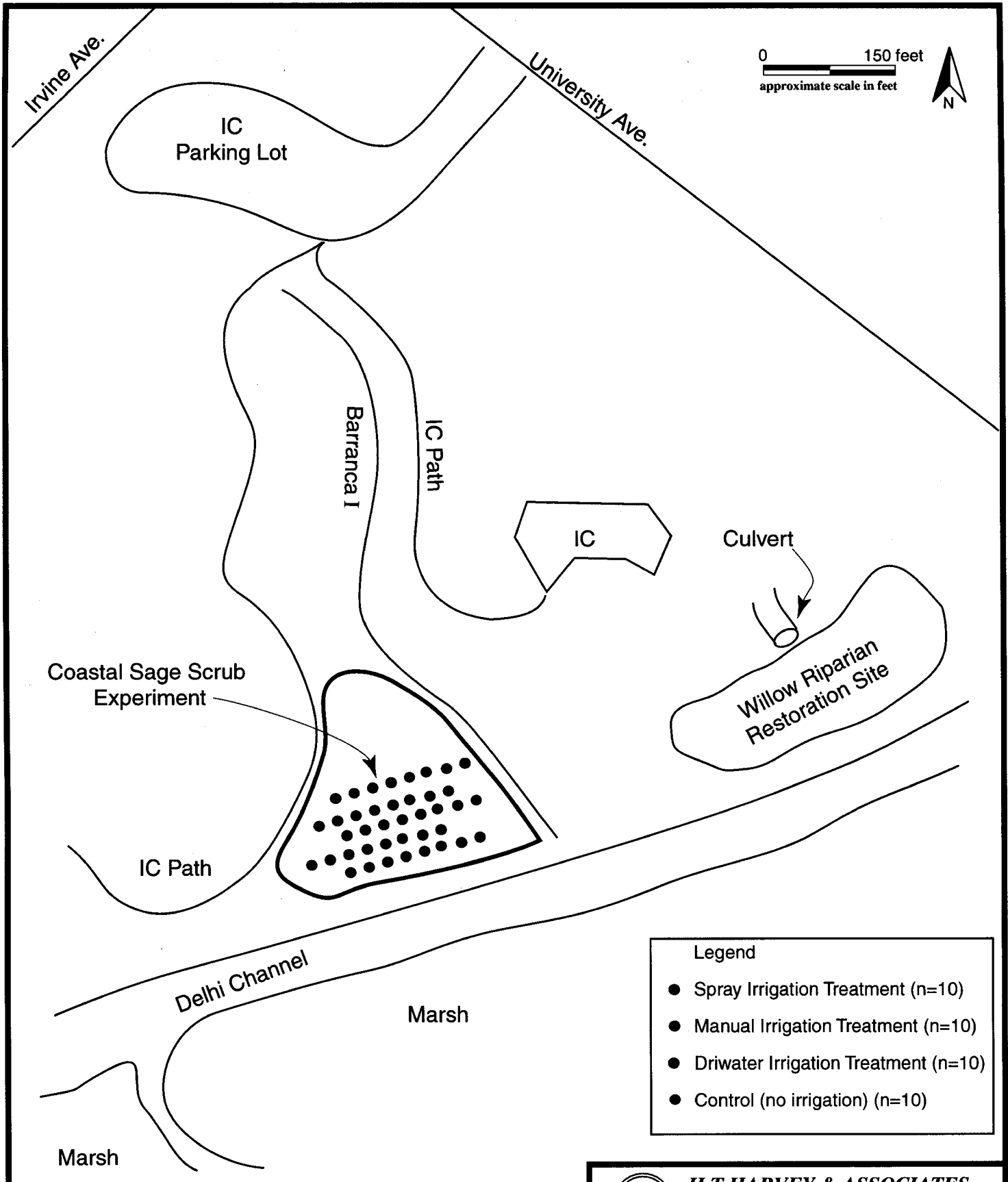
Planting will be used in order to improve the chances for success of the restoration and the experiment. The experiment will focus on four of the dominant coastal sage scrub plant species present in existing sage scrub patches around UNB. Direct seeding will only be utilized in a site pretreatment with grasses and forbs that will be broadcast first then pressed into the ground after mycorrhizal inoculation (see methods below).

Irrigation will be the other major component of the study. Several methods will be studied in order to ascertain which method will both sustain the plantings and work with the community-based restoration constraints. Three irrigation methods will be employed in the experiment: spray irrigation, DRiWATER ™, and hand irrigation with collars (similar to a common technique called "deep pipe irrigation"). The experiment will include a control with no irrigation. These irrigation methods cover a variety of techniques that will offer choices that work successfully within the constraints of the project.

SITE PREPARATION

Location

The site for the coastal sage scrub experiment is located at the down slope, southern end of Barranca I (Figure 3) at the IC (Figure 2). In order to gain sufficient statistical power, we estimate 40 replicate plots will be required. Therefore, an area sufficient for 40 replicate plots will need to be prepared (see below). The plots are 20-foot diameter circles (a standard spray irrigation head reach) that will need to be separated both for access needs and for treatment isolation. A total of 28,274 ft^2 (0.65 acres) will be required to fit forty 20-foot diameter plots with 10 feet of spacing between the edges of each plot. The site should be fenced with some aesthetically pleasing fencing (e.g. wooden split-rail) and some detailed interpretive signage to bring the restoration to the attention of the public. The fencing and signage should minimize human disturbance/damage as well as serve an outreach function.



Note: Treatments should be assigned to the replicate experimental plots in a stratified-random manner - This is an example layout.

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Upper Newport Bay Restoration Education Project:
Plan View Coastal Sage Scrub Experimental Layout

File No. 2174-01	Date 11/8/02	Figure 3

Weed Removal

The herbaceous vegetation (primarily mustard) at the site should be flail-mowed (using a weed-whacker) and the duff left in place. No raking, spreading, or removal should be performed. Raking would likely increase mustard germination. As the duff decomposes, the carbon will facilitate bacterial (immobilization) uptake of inorganic nitrogen in the soil. The competitive advantage enjoyed by mustards, like most ruderals, stems in part from the high availability of nitrogen at disturbed sites. The loss of available soil nitrogen diminishes their competitive ability and can shift the competitive advantage to the target native species (SERG, 2002).

Seeding

After weed-whacking, the site should be manually seeded using a rotary seeding device (a.k.a. belly grinder) with the seed mix and application rates shown in Table 1 (Appendix A). To the extent possible given availability, the seed should be derived from source populations located in Orange County. Broadcast seeding should be timed with the onset of the rainy season (November- January). This mixture includes native grasses and composites that will help reduce the mustard abundance via competition and will enhance soil conditions for establishment of a mycorrhizal community. Mycorrhizae refers to the symbiotic relationship that occurs in nature between the roots of many plant species and one of many types of specialized fungi (Smith and Read 1997). Mycorrhizal fungi are essential for a healthy and diverse coastal sage scrub community (Evans et al. 2002, Chaudhary and Griswold 2001, St. John 1996). Furthermore, the composites, and even the grasses in the seed list will introduce other parts of the community (discussed in the long-term management section). Tree of Life Nursery recommended S & S Seeds for purchase of native grass and forb seed (Carpenteria, California (805) 684-0436).

The mycorrhizae must be incorporated into the soil profile close to the roots of host plants. The seed and commercial mycorrhizal inoculum can be introduced together in a process called "imprinting". Imprinting is performed with a specialized piece of equipment towed by a tractor that presses the seed and mycorrhizae into the soil while creating microtopographic depression for increased rainfall and moisture capture. There are landscape contractors that can perform this (e.g., Nature's Image, Lake Forest, California) however this would not be community-based restoration. Therefore, below we propose some alternatives to that method.

One possible imprinting method that could be implemented manually by volunteers would entail the use of a steel-drum roller. This is a simple and widely available tool that is used to flatten worked soil or laid sod. It is a 55-gallon drum (filled with water) that is controlled with a large handle attached to a hub on either end of the drum. Chevrons, like those used for tractor wheels, could be welded onto the drum to mimic the microtopographic depressions of the commercial imprinters and facilitate pressing the seed into the soil. If the drum is infeasible, the other method is for volunteers to simply walk over the area after it has been seeded to press the seed into the ground. Both of these methods will require moist soils (watering if necessary).

Mychorrizal Inoculation

After seeding and imprinting, mycorrhizal inoculum should be incorporated into the soil. Volunteers can simply use a maddox or a shovel to work the mycorrhizae into the soil. The method should disturb as little of the soil surface as possible to reduce the recruitment of weeds. A maddox, or pick-axe, can be used to create holes by inserting the pick-end and pulling back towards the user (but not removing the dirt), then a teaspoon of inoculum poured into the bottom of the hole, and the loose soil used to bury the mycorrhizae. A shovel can also be used to create slits, by inserting the shovel and pulling it back towards the user but not removing the soil. Both of these methods should be performed on two-foot centers for the entire area of the restoration. The mycorrhizae should be inoculated at a depth of approximately 3 inches (Evans et al., 2002).

IRRIGATION TREATMENTS

Plot Design

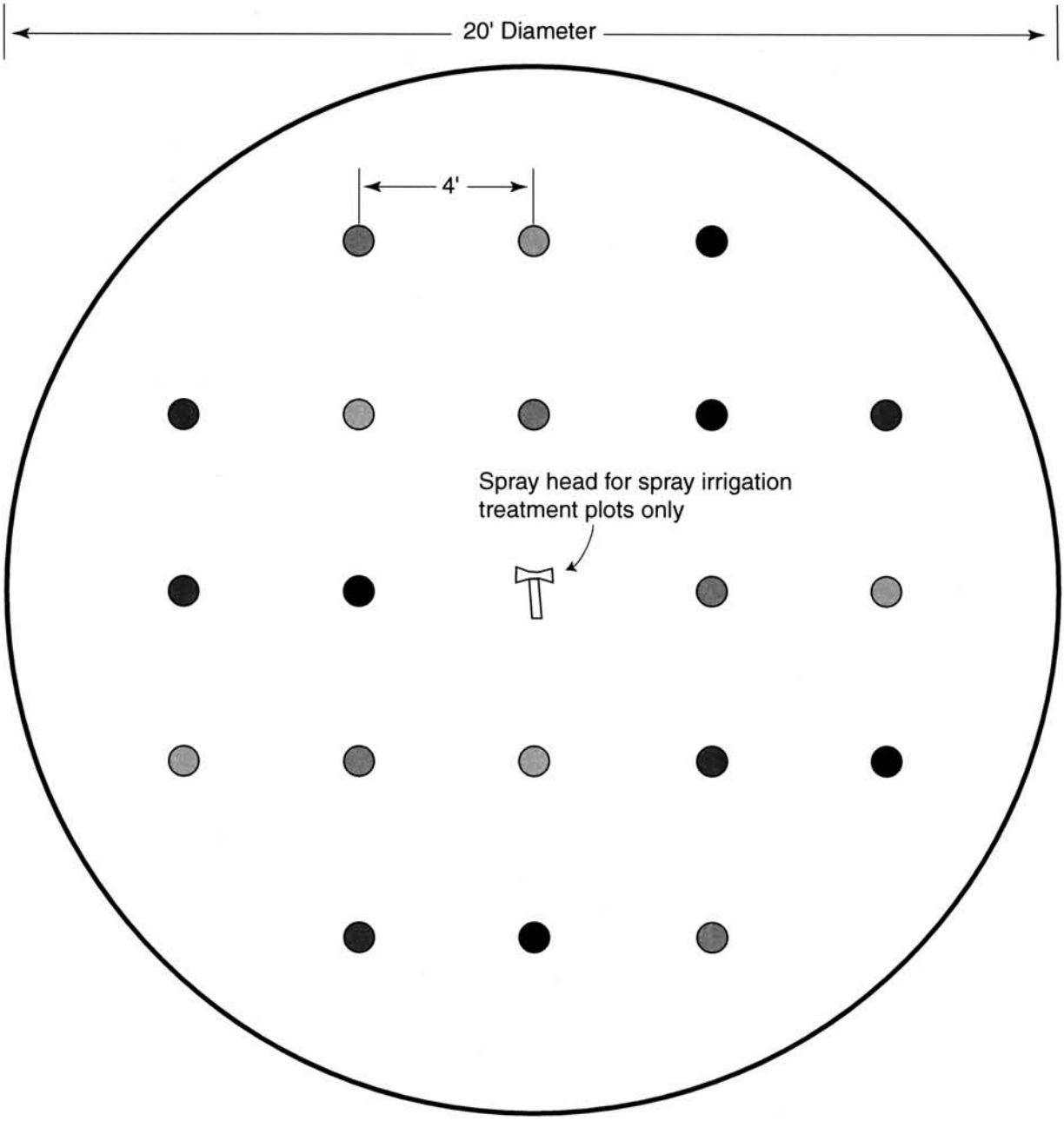
The irrigation treatments include 10 spray, 10 DRiWATER ™, 10 hand in collar, and 10 control plots (no irrigation). The experimental layout is shown in Figure 3.

Spray Irrigation Treatment

A detailed spray irrigation system design by a qualified irrigation designer will be required. The design will be suitable for installation by a Landscape Contractor or by a volunteer group led by someone with irrigation installation experience. The system would consist of a total of 10 shrub, riser spray heads with 1 spray head positioned in the center of each of the 10 spray irrigation plots shown in Figure 4. Adjustable, 12-foot spray nozzles should be utilized; either Rainbird Heads (PCS) or Torro Heads (PCD). Each of the 12-foot spray nozzles would be manually adjusted to cover each of the 10, 20-foot diameter treatment plots and to minimize spray beyond the plot boundaries. Since the spray irrigation regime for each of the 10 plots would be identical, a battery operated, single station controller and a single valve would be sufficient.

In Year 1, the spray irrigation plots should be irrigated once per month in April-May, twice per month in June-August, and once per month in September-October. Spray irrigation Year 2 would be reduced to once per month from April through October. Spray irrigation should be utilized in Year 3 only if required and will not be required after Year 3. The total spray irrigation run time per irrigation event should be calculated to thoroughly moisten the upper 6 inches of the soil profile. An accurate estimate of the total run time will require measurement of the soil texture and estimated infiltration rate at the site. This should be done during the detailed irrigation design. For example, assuming that the soil texture for the site is a loam, a total run time of approximately 64 minutes would be required per irrigation event given the Orange County climate (Munion, personal communication, October 31, 2002).

The total run time may need to be separated into a number of shorter segments to avoid runoff. This should be determined in the field after spray irrigation system installation and prior to planting. We had initially prescribed the installation of small earthen berms on contour between the experimental rows to ensure that runoff from an upslope spray irrigation treatment would not



Legend

- California Sagebrush
- Black Sage
- California Encelia
- California Buckwheat

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Upper Newport Bay Restoration Education Project:
Plan View of Typical Plot

File No. **2174-01**	Date **11/8/02**	Figure **4**

enter a downslope manual, driwater, or control treatment. We have deleted these berms from the experimental design based on reviewer comments under the assumption that the spray irrigation application will be carefully field fitted to avoid substantial runoff.

A detailed spray irrigation system design would cost approximately $500-1000 assuming that information on the location of the water source line, water pressure, and need for back-flow prevention could be obtained without a site visit. Installation of a spray irrigation system for the 10, 20-foot diameter spray irrigation plots is estimated to cost approximately $ 2000-4000 if performed by a landscape contractor. This is a preliminary cost estimate as the detailed spray irrigation design has not yet been prepared.

DRiWATER ™ Treatments

As this method will be utilized over several years, we recommend initially purchasing the 3-inch "tube" product (permanent water system) and then replacing the gel pack "inserts" from then on. Based upon the DRiWATER ™ company's specifications, each planting will require 2 tubes with the gel packs being changed at least every 90 days (www.driwater.com), although this can be field adjusted to compensate for soil moisture retention characteristics as well as plant and weather factors. Plants should be hand watered through the tube (approximately 1-gallon per planting) while changing the gel packs (DRiWATER, 2002). DRiWATER gel packs will be replenished throughout years 1 and 2 after planting. They should be replenished in Year 3 approximately once every 6 months. Replenishment of gel packs should not be required after Year 3.

Manual Irrigation Treatment

Hand irrigation will include fitting the planting with a plastic collar (H. T. Harvey & Associates, 2001). The collar design is for "deepot" sized container plants but the method can be adapted for other container sizes if necessary. The collar focuses the watering down into the root zone. The collar is a plastic container approximately 6-inches long by 5-7 inches in diameter with the bottom removed. A container made of a thin walled plastic such as a yogart container is preferable. The collar can either be placed in the planting hole or worked into the un-tamped soil around the planting to approximately 4-inches depth. The approximately 2-inch long portion of the collar left above the soil surface is to hold water during irrigation.

Manual watering will consist of applying 1-gallon of water per plant per irrigation event. The irrigation should be paced not to overflow the collar capacity. During Year 1 after plant installation, manual watering can generally follow a schedule of: 2 times per month in April-August, and 1 time per month in September and October. As with spray irrigation, the frequency of manual watering should be reduced in Year 2 to approximately once per month in April-October. Irrigation should not be required from Year 3 on. However, it should be noted that weather should fine-tune this schedule such that in months where significantly more or less rainfall accumulates the watering schedule should be adjusted accordingly. Coastal sage scrub communities generally require little water and their root systems easily rot if over-watered (H. T. Harvey & Associates, 2001).

COLLECTION OF TOPSOIL/MYCORRHIZAL INOCULUM

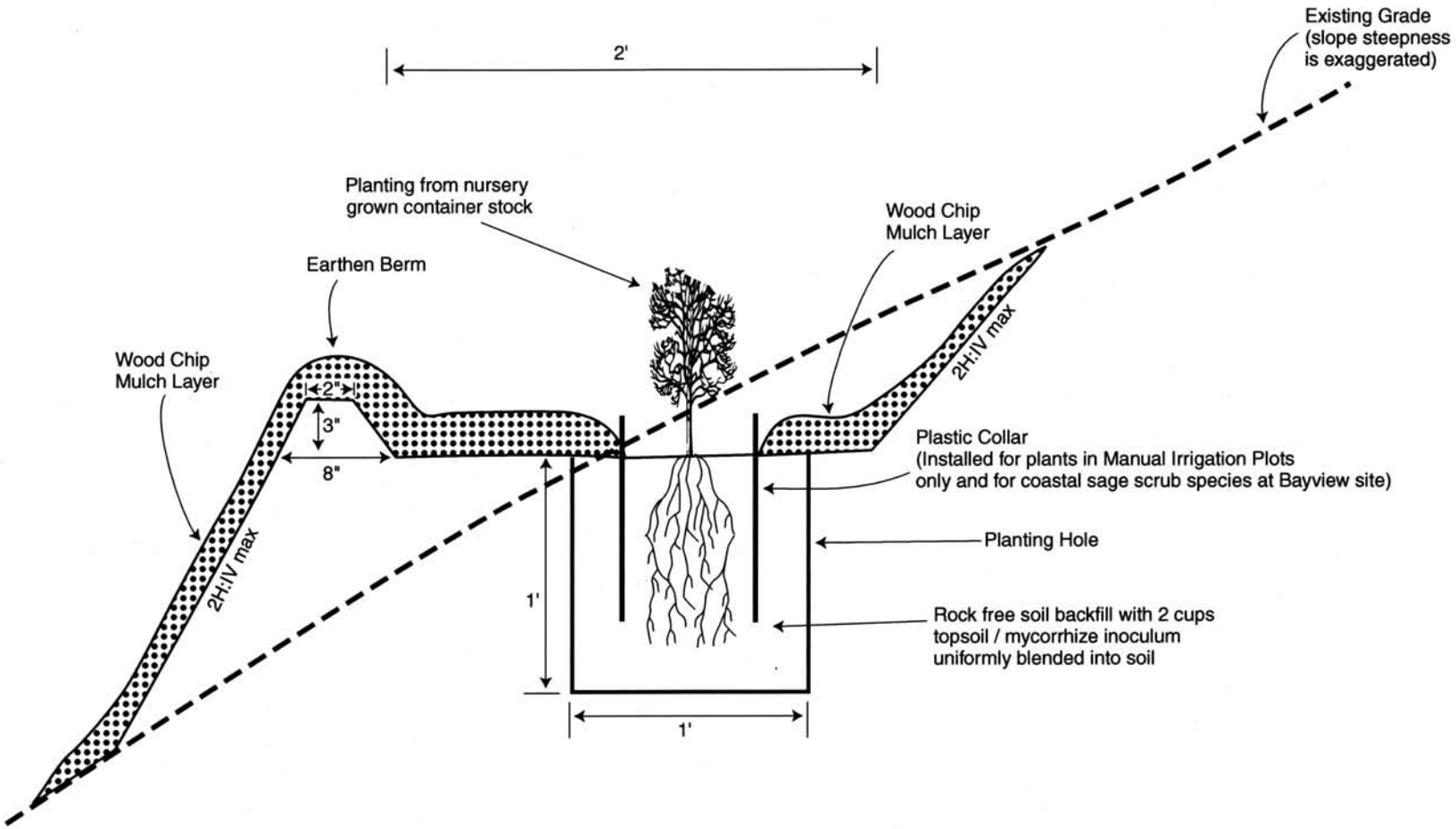
Topsoil/mycorrhizal inoculum will be harvested from the upper 1-inch of topsoil within nearby coastal sage scrub habitat dominated by the species being installed in the revegetation experiment. Two cups (16 oz.) of this topsoil/mycorrhizal inoculum will be hand-blended with soil removed from the planting holes (see Plant Installation below). A total of approximately 13.3 cubic feet (20, 5 gallon plastic buckets) of topsoil/mycorrhizal inoculum will be required for the 800 shrubs to be planted.

PLANT INSTALLATION

Four dominant coastal sage scrub plant species will be planted in the plots: California sagebrush (*Artemesia californica*), black sage (*Salvia mellifera*), California encelia (*Encelia californica*), and California buckwheat (*Eriogonum fasiculatum*). These species and their planting specifications can be found in Table 3 (in Appendix A below). There are a total of twenty planting locations in each 20-foot plot; therefore, there are a total of 5 individuals of each species in each plot. Overall there are 200 individuals of each species for a total of 800 plants in the experiment. The planting locations within each plot should be flagged using pin flags labeled by species prior to plant installation. This will help facilitate coordination of plant installation with the volunteers. The 20 plants should be randomly distributed by species within each plot. Figure 4 provides an example of the plant species layout within a typical plot.

Install plants in accordance with the typical detail provided in Figure 5. Earthen, irrigation basins should be installed at all planting locations regardless of treatment. These earthen basins function to retain irrigation water and runoff from precipitation to increase soil moisture within the rooting zone of the plantings. The 24-inch radius crescent-shaped irrigation basin with a 3-inch high earthen berm should be constructed for each planting (Figure 5). Cover the basin bottom and berm with a 3-inch thick layer of mulch consisting of wood chips or shredded tree bark. Mulch should be free of other materials.

Plants should be installed between November and January after the onset of winter rains. Water plants in their nursery containers the morning of the day they are to be planted. Dig planting holes that are a minimum of 2 times the width and 1.5 times the depth of the containers. Thoroughly wet the holes prior to plant installation. Plants should be removed from their containers in such a manner that the root ball is not broken and installed immediately after removal from the container. Uniformly mix 2 cups of topsoil/mycorrhizal inoculum harvested from nearby coastal sage scrub habitat into the backfill soil. Back fill the hole with the soil and lightly compact the soil to remove any air spaces between the roots and soil. Immediately after plant installation, irrigate the planting basins with approximately 3-5 gallons of water to saturate the planting's interface with the surrounding soil. Install plants so that their root crowns are at or slightly above (up to ½ inch) grade following soil settlement that occurs after initial irrigation.



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Upper Newport Bay Restoration Education Project:
Typical Plant Installation Detail with Collar

File No. 2174-01	Date 11/8/02	Figure 5

MAINTENANCE

Maintenance will consist of irrigation and weed control during a 2-3 year plant establishment period. Irrigation can be tapered off every year such that in the second year irrigation is 25-50% less frequent, and in the third possibly not at all (See irrigation treatment section above). But this must be field-fit to inter-annual variability in the weather and the growth of the plantings (see monitoring below).

The site preparation techniques proposed (wood chip mulch, seeding, mycorrhizal inoculation) should reduce weed growth and weeding requirements. However, weeds should be controlled within the irrigation basins/wood mulch area around each of the plantings. The weed control treatment should be identical across the irrigation treatments so that it does not introduce an additional treatment factor and associated variability in plant growth response. The irrigation basins should be kept weed free by manual removal. Weed-whacking of herbaceous vegetation between the plantings is not recommended for this experiment.

The irrigation system should be inspected regularly. Any damage should be repaired as soon as possible not only for water conservation reasons but also for the coastal sage scrub community susceptibility to water-logging induced mortality. The planting basins should be repaired as needed, as well as the mulch replenished for the first three years to maintain a 3-inch depth of mulch.

QUANTITATIVE MONITORING

Two vegetation response variables will be monitored for the container plants in the coastal sage scrub restoration experiment: percent survival by shrub species installed and crown volume by shrub species installed. Data for all plantings should be collected immediately after the plantings are installed to establish a baseline. Data should be collected one time per year in May-June.

Percent Survival

Percent survival will be measured by species and by irrigation treatment by counting all live, planted individuals. The locations and species identification of all species planted should be marked with wood lathe in all treatment plots.

Percent Survival Species A= (number of individuals species A alive/number of individuals species A originally installed) * 100

Crown Volume

Crown volume has been shown in many studies to be an accurate predictor of the total leaf biomass of shrubs. One height and two crown width measurements will be taken. Because species to be planted all have an irregular canopy outline, an average of two crown diameter measures will be taken. Shrub crown volume will be measured using a measuring tape. The first diameter (*a*) will be recorded through the longest dimension of the canopy. The second crown diameter (*b*) will be recorded in the perpendicular direction (at right angles) to the first

dimension. Maximum height (h) will be measured from the soil grade immediately downslope of the root crown to the tallest, living, freestanding part of the shrub whether stem, branch, or leaf. Shrub parts should not be manually extended to maximize the standing height. The crown volume will then be calculated using the following equation:

$$V = h\,[\,\pi\,(d/2)^2\,];\ \text{where}\ d = \frac{a+b}{2}$$

The crown volume of each live shrub will be recorded by treatment group (species and irrigation regime).

STATISTICAL DESIGN

The analysis would be for a 4X4X5 (4 species X 4 irrigation treatments X 5 elevation rows) Randomized Block Design with the block on row (or elevation); the randomization is stratified on elevation such that all treatment levels fall evenly into all elevations (Figure 3). This stratification of the experimental units will enable one to determine if elevation exerts a detectable influence on plant growth and to control for that environmentally induced variability. Alternatively, a 4X4X5 Stratified Random Design could be utilized, however, one would first have to test it as a split-plot design to ensure independent samples (the rows). Elevation is included in the model based upon the possibility that it may contribute significant variability across plots. If it is insignificant, it can be pooled later, adding more power to the experiment. Data will consist of percent survival for each individual species replicate (n=5) in an irrigation plot (n=10) and the average crown volume of that species' individual replicate. These two datasets should be analyzed separately as they are redundant. Both datasets can be analyzed using the ANOVA model in a statistical program (Table 1). Microsoft Excel is not recommended for the ANOVA analysis; there are many reports that its algorithms are incorrect for ANOVA.

Table 1. Example ANOVA Table.

Effect	ss	df	mse	p
Irrigation	xx	3	xx	xx
Species	xx	3	xx	xx
Elevation (Block)	xx	4	xx	xx
Irrigation X Species-Interaction	xx	15	xx	xx

BACKGROUND AND OBJECTIVES

Riparian habitat is another heavily impacted habitat near UNB and throughout California. Due to the number of drainages into UNB and the amount of non-native grassland habitat observed at some of these sites, there is great potential for riparian habitat restoration work in these areas that can be included in the community-based restoration program.

Riparian habitats in Southern California are typically dominated by willow (*Salix* spp.), cottonwood (*Populus* spp.), sycamore (*Platanus* spp.), and/or oak (*Quercus* spp.) species. The plant community composition of riparian habitats varies with the geographic and geomorphic setting. This section is focused on the restoration of willow-dominated riparian habitat. Willow- and cottonwood-dominated riparian habitats harbor among the highest diversity and abundance of wildlife species of all the habitat types in California. Willow-dominated riparian habitat is important for nesting and foraging of numerous special-status species. For example, the endangered Least Bell's Vireo (*Vireo bellii pusillus*) breeds in willow-dominated riparian habitat and has been observed at UNB.

An experiment is proposed below to test the effectiveness of three willow revegetation techniques: willow cuttings, stakes, and poles (H. T. Harvey & Associates, 2002). These three types merely differ in their size, however this experiment, along with the groundwater depth sampling will allow for the successful replication of this technique in other settings around UNB.

The design consists of using the three types of willow propagation at two sites in conjunction with a simple groundwater dipwell and correlating the success of the plantings to groundwater depth. In the future, groundwater depth can be measured and the appropriate willow propagation type can be used.

METHODS

This experiment will be run at the seasonal wetland area created by the parking lot's discharge culvert directly downhill from the IC (Figure 2); it could also be applied to the bank slopes along Santa Isabel Channel (Figure 2). Both settings currently support riparian and seasonal wetland species in different hydrologic settings and could provide different results and information. The methods applicable to the two sites are described below. A large lollypop tree occurs at the willow riparian restoration site down slope of the IC. This non-native tree should be removed per the methods described in Appendix B prior to willow revegetation.

Plant Procurement

Willow cuttings will be harvested from healthy stands of existing willows within the UNB watershed. A healthy stand of willows, from which all or a portion of the planting material could be harvested, occurs adjacent to both the willow restoration sites. To preserve the vitality of

donor willow trees, no more than 25% of the branches from donor trees shall be denuded or striped. This level of pruning of existing willow trees will not reduce the vitality of the donor trees.

Larger diameter cuttings have a greater supply of stored energy for rooting than smaller diameter cuttings. Bigger diameter and longer lengths are better suited for severely eroded areas and fluctuating water levels. This experiment should indicate which type of cutting is most effective for different types of sites.

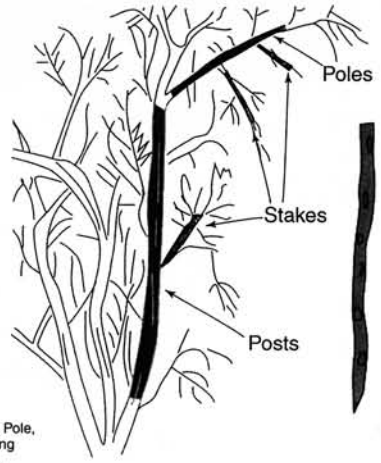
The three sizes of live willow cuttings (posts, poles, and stakes) should be collected in January or February during the dormant season to ensure the highest success rate. When harvesting live cut branches, select healthy, living wood from multiple locations within the UNB. The wood should be 1-4 years old for willow posts, 1-2 years old for willow poles, and one year old for willow stakes. All should be reasonably straight. Figure 6 provides harvesting and planting details for willow posts, poles, and stakes.

Willow Posts. Willow posts should be harvested and prepared by thinning sapling and young trees ranging from 3-6 inches diameter from the adjacent willow thicket. Post cuttings should be prepared by trimming off the top of the tree to remove the terminal bud, allowing the majority of the energy in the stem to be sent to the lateral buds. All side branches should be trimmed off, and post will then be cut in approximately 6-foot lengths. The straightest portion of the bole should be used. Side branches, tops, and smaller pieces should be salvaged for pole and stake cuttings. The bottom of the post should be cut to a point to facilitate planting. Cut the top of the post flat or blunt.

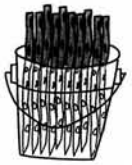
Willow Poles. Willow poles should be harvested and prepared by cutting new sapling trees 2-3 inches in diameter or similar sized branches left over from post preparation. All side branches should be removed and cut in approximately 4-foot lengths. The pole should be as straight as possible. The bottom of the pole should be cut to a point to facilitate planting.

Willow Stakes. Willow stakes should be harvested and prepared by cutting new sapling trees 0.5-1.5 inches in diameter or similar sized branches left over from post and pole preparation. All side branches should be removed and cut in approximately 2-foot lengths. The stake should be as straight as possible. The basal end will be cut cleanly at an angle to enable it to penetrate the subsoil. The top will be cut flat or blunt to tamp in. Live stakes should be planted the same day they are cut. If not, they will be stored in water, basal end down and inundated from 60-80% of their length for a maximum of two days.

Immediately after harvesting, post and pole cuttings should be soaked for 5–7 days in "willow water" (i.e., water with small diameter green willow branches placed into the container). Store the cutting outdoors in the shade. Soaking in willow water will improve rooting of large diameter willow material. Posts and poles should be placed basal-end down and inundated from 60 to 80 % of their length. Posts and poles will need to be planted as soon as possible after soaking.



Willow Stake, Pole, Post Harvesting DETAIL

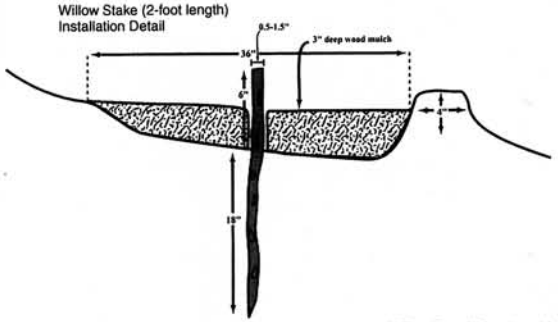


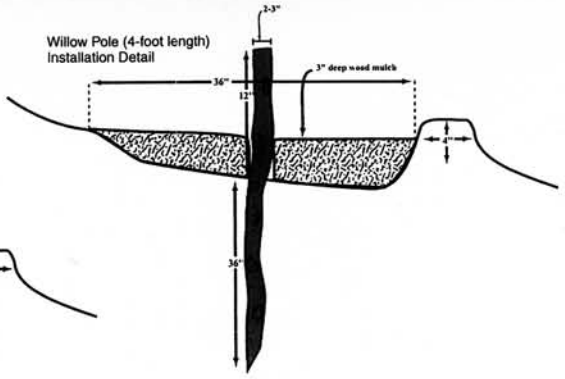
① Harvest willow planting materials from the existing willow on the drainage. Select healthy wood from two or more locations within the collection area. No more than one-third of any single tree should be harvested. Cut reasonably straight branches.

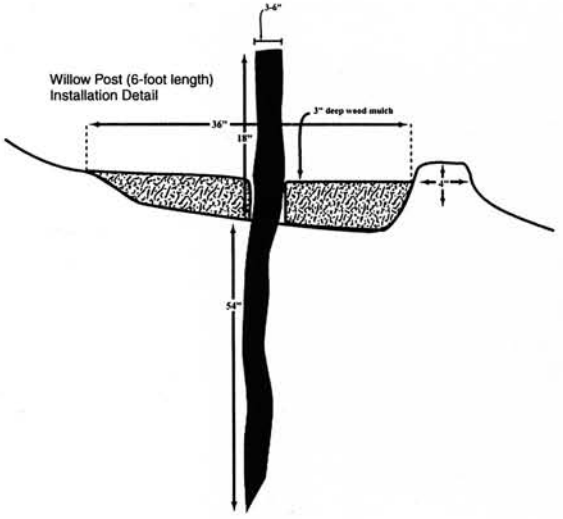
② Trim off all side twigs flush to the branch.

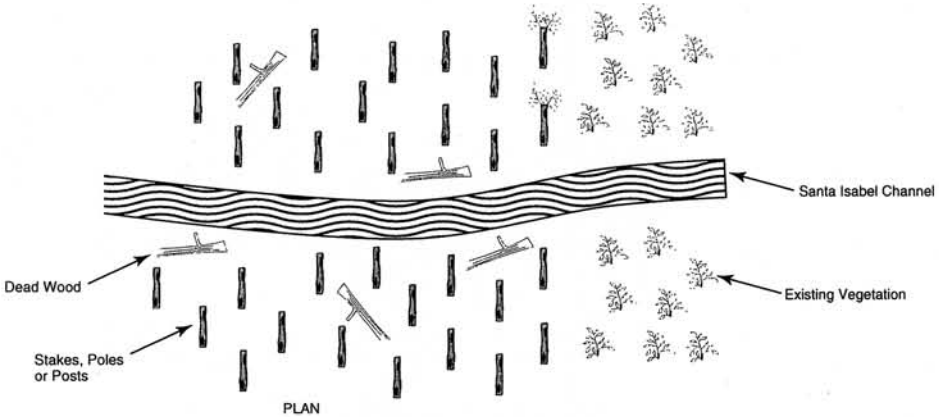
③ Bottom of stake shall be cut to a point to facilitate planting.

④ Top of stake shall be cut flat.









PLAN

① Cuttings should be installed in alternating rows with approximately 6-feet on-center triangular spacing.

Not To Scale

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Upper Newport Bay Restoration Education Project
Willow Cutting Installation Details

File No. 2174-01	Date 11/8/02	Figure 6

Site Preparation

No work should take place in the live stream channel; therefore, a low flow period should be chosen for harvesting and planting. No equipment or debris (sediment, trash, willow pieces) should be allowed to enter the stream channel. Erosion control measures should be employed whenever heavy equipment or digging operations could cause sediment to enter Waters of the State. These could include silt fencing or other standard erosion control devices. The sites should be fenced with some aesthetically pleasing fencing (e.g. wooden split-rail) and some detailed interpretive signage to bring the restoration work to the attention of the public. The fencing and signage should minimize human intervention as well as serve an outreach function.

Installation Procedure

Willow posts, poles, and stakes should be installed on approximately 8-foot centers throughout the planting areas. The planting area at the IC site is shown in Figure 2. The IC site planting area is defined by the footprint of one lollypop tree and a patch of anemopsis (*Anemopsis californica*), a wetland indicator species. This planting area is approximately 25,000 square feet in size. Therefore, approximately 390 willow plantings (130 stakes, 130 poles, 130 posts) will be required if installed on approximately 8-foot centers (rectangular spacing).

In cross-section, the area at the Santa Isabel Channel Site should start at the ordinary high water mark (approximately 2 year event) of the channel and extend upslope to a distance from the channel equivalent to that of downstream willow riparian habitat. See Figure 5 for a typical installation detail.

It will be easier to locate and harvest stakes and poles as opposed to the larger posts. The number of stakes and poles could be increased and the number of posts decreased depending on the level-of effort required to locate and harvest posts.

Willow Posts. Holes approximately 4-5 feet deep by 7 inches wide will be augured. As the auger is removed from the hole, the installer will immediately install the post into the hole. The post will be installed to a depth equivalent to approximately 3/4 the post's length. Care will be taken to ensure that the upright end is exposed (i.e., the end that was up prior to being cut) and the basal end pushed into the soil. The hole will be backfilled around the post with mud slurry. A metal cap will be placed over the post to protect the cutting if it is going to be pounded into the subsoil with a sledgehammer. After the cap is removed the post will be cut so that 1-2 feet of the post is left above ground.

Willow Poles. Holes approximately 3 feet deep by 4 inches wide will be augured. As the auger is removed from the hole, the installer will immediately install the post into the hole. The pole will be installed to a depth equivalent to 1/2 to 3/4 the pole's length. Care will be taken to ensure that the upright end is exposed (i.e., the end that was up prior to being cut) and the basal end pushed into the soil. The hole will be backfilled around the pole with mud slurry. A metal cap will be placed over the pole to protect the cutting if it is going to be pounded into the subsoil with a sledgehammer. After the cap is removed the pole will be cut so that 0.5-1 feet of the post is left above ground.

Willow Stakes. Pilot holes approximately 1 foot deep by 0.5-1 inches wide will be augured. A 0.5-1 inch diameter rebar post can also be used to make the pilot hole. The stake will be installed to a depth equivalent to 1/2 to 3/4 the stake's length. Care will be taken to ensure that the upright end is exposed (i.e., the end that was up prior to being cut) and the basal end pushed into the soil. The hole will be backfilled around the stake with mud slurry.

EXPERIMENTAL DESIGN

The objective of the experiment is to determine the effect of groundwater elevation on the relative success of willow posts, willow poles and willow stakes. It would be convenient if stakes (the smallest cutting) were appropriate for all sites; however stakes may not be effective in sites like the IC Site where groundwater may be relatively deep.

Therefore, the concept for planting the three types of cuttings at the two sites should focus upon placing the types across the environmental gradient, just like in the coastal sage scrub experiment (above). At the IC site, that would mean randomly installing some tall cuttings at the lower portions of the restoration area and some short cuttings at the top of the area. Although this is counterintuitive, the point is to ensure that all types are spaced along the hypothesized environmental gradient and all possible combinations are created.

The exact gradient will be monitored using shallow groundwater dipwells. The dipwells will be installed using the same auger that installs the pole or post cuttings (depending upon the diameter of pvc pipe chosen. The pvc pipe should have the lower opening capped with a glued pvc pipe cap (pvc pipe glue). The upper opening should also use a pvc pipe cap but left so that it can be opened for readings (select a tight fitting cap for the top so it will stay on better). Slits should be made in the sides of the pvc pipe (with a band saw or other type of similar cutting instrument) every 6 inches to allow groundwater to seep into the pipe. The level of the groundwater will equilibrate with the level of water in the pipe allowing for measurement from the surface. This can be accomplished with a flashlight attached to a measured string or rope: when the light goes out it is at the level of groundwater.

The dipwells should be installed at even spacing along the hill or bank slope in alignment with the cutting installations. Readings should be taken often enough to measure the groundwater's reaction to rainfall or tidal events, depending upon the hydrologic forces at play in the location.

The data gathered for this experiment should include cutting survival (yes/no), cutting height, and groundwater depth (from the surface). The cutting survival and height can be compared to the depth to groundwater, using an ANOVA like the coastal sage scrub experiment, and future willow restoration efforts can utilize this information.

RESTORATION OF THE BAYVIEW SITE

INTRODUCTION

The Bayview site is located between existing salt marsh habitat and a bike/pedestrian path approximately 0.6 miles east of the IC. The proposed restoration plan for this site involves the conversion of iceplant and mustard dominated areas to high salt marsh, marsh/scrub ecotone and coastal sage scrub habitats.

The Bayview Site was selected for restoration based upon the following:

1) The area provides restoration opportunities for coastal sage scrub, High Marsh, and the ecotone between the two habitats, allowing for experience with both habitats.
2) The area contains several of the invasive species known to occur at UNB, allowing for experience with the eradication techniques.
3) The area will soon contain a public viewing platform, so any restoration in this area would have excellent outreach potential.

Although the Bayview site is 18.5 acres in total, community-based restoration techniques cannot restore this large an area at once. The area should be tackled in discrete phases. Therefore, the restoration plan proposed below addresses an approximately 0.5 acre portion of the Bayview site that will serve as first phase of restoration in this area. The ultimate goal is to apply the lessons learned from this smaller restoration project, as well as the two above experiments, to the entire 18.5 acre site.

Restoration of the Bayview site will include the isolation of sensitive habitats (do not disturb areas) to limit the influence of the restoration activities upon surrounding habitats. Qualified personnel should perform this portion of the work. The boundary can be staked, but some temporary fencing such as construction fencing is generally more effective.

Once the boundaries of the restoration are established (in this case CDFG should also be consulted due to their proposed activities in the adjacent areas), invasive species removal can commence. The methods for removal of the invasive species found on site are included in the coastal sage scrub experiment section and Appendix B. Invasive species are usually an ongoing management issue, however, the level-of-effort will greatly diminish over time as the target habitat develops.

It should be noted here that the plantings required for the project, as well as any other supplies such as seed, should be secured ahead of the scheduled work period. Some plant species are not in stock at all times so nurseries generally request a year of lead time to ensure availability for your project.

METHODS

Site Preparation

The site preparation should proceed much like the coastal sage scrub experiment (outlined above) for the coastal sage scrub and ecotone areas. Therefore, the methods will not be reiterated here. Seeding and micorrhizal inoculation will not be required in the high salt marsh restoration areas. The high marsh areas will require less preparation (e.g., seeding and mycorrhizal inoculation). Due to the lack of suitable base materials and the undefined but adjacent CDFG restoration work, this restoration area was not mapped or quantified. We have created a generalized cross section that should give sufficient information to allow the final site to be partitioned into coastal sage scrub, high marsh, coastal sage scrub-high marsh ecotone, and willow riparian target habitat areas (Figure 7). Furthermore, the planting specifications are sufficient to create the detailed plans and specifications needed for planning. The site should be fenced with some aesthetically pleasing fencing (e.g., wooden split-rail) and interpretive signage should be installed to bring the restoration to the attention of the public. The fencing and signage should minimize human intervention as well as serve an outreach function.

Once the invasive species have been removed according to the specifications for mustard in the above coastal sage scrub experiment combined with the California Coastal Commission's current iceplant removal method, the coastal sage scrub areas can be pretreated with the mycorrhizae and seeded (please refer to the coastal sage scrub experiment for these methods). The pretreatment can be set up for coastal sage scrub planting after it has matured or can be left and planted the following year.

Soil amendments beyond mycorrhizae and grass-forb seeding for the coastal sage scrub were not explored since the site is currently supporting target vegetation in surrounding areas.

Plant Installation

The recommended procedure is to have a nursery contract grow the container plants from propagules collected from within the UNB watershed. Contract growing will usually require a deposit and may take a year of lead-time. If this is not acceptable, you can try and acquire as much of the planting material as possible and adapt the methods to the types available. Direct seeding of coastal sage scrub was not addressed in this report but it may be a valid option with the correct methods.

Tables 2 and 3 (Appendix A) provide the preferred growing container and an alternate container or method where applicable. Plantings that pass visual inspection and are accepted from the nursery should be installed as soon as possible. If they are to be stored, they should be protected from desiccation and browse in a temporary nursery structure. The high marsh species and their specifications are listed in Table 2 in Appendix A. The coastal sage scrub plantings and their specifications are listed in Table 3, also in Appendix A. The planting palette for the high salt marsh association was based on the species composition of the high marsh community adjacent to the ice plant infested area. The plant species diversity of the surrounding salt marsh on site

Existing Habitats

Open Water | Mudflat | Saltmarsh | Saltpan | High Saltmarsh / Ruderal | Willow / Arundo / Myoporum | Iceplant / High Marsh | Ruderal | Bike Path

Proposed Habitats

Open Water | Mudflat | Saltmarsh | Saltpan | High Saltmarsh / Coastal Sage Scrub Ecotone | Willow | High Marsh / Coastal Sage Scrub Ecotone | Coastal Sage Scrub | Bike Path

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Upper Newport Bay Restoration Education Project: Bayview Site Typical Cross-Section

File No. **2174-01** | Date **12/27/02** | Figure **7**

was relatively high and with tidal influence the surrounding marsh should supply seed to the restoration area that will augment the plantings proposed. Conversely, the coastal sage scrub species diversity within the site vicinity was relatively low and species recruitment would occur much slower due to the lack of adequate diversity in the site vicinity. Therefore, the coastal sage scrub planting palette (Table 3) was not only based on the composition of the surrounding coastal sage scrub community on site, but was augmented with the California Native Plant Societies' "Coast Prickly-Pear Series" list (CNPS 2002). The broadcast seed species list (Table 1) was created from species described in Ainsworth and Doss (1995) and from species recommended by Tree of Life Nursery (personal communication, 2002).

The general idea is to maximize diversity within the bounds of the community's structure while keeping the plantings within that communities' range (see Figure 6). This may be accomplished in the field by surveying the surrounding vegetation to approximate the appropriate geomorphic setting (i.e. tidal marsh fringe for high marsh species, above the high marsh species for coastal sage scrub species or inland locations protected from tidal influence, and in-between for the ecotone mix). The on-center spacings recommended in Tables 2 and 3 (Appendix A) take into account the mature species size and in some cases its relative abundance in a community ('rare'). The percentage of the plantings is a planning guideline that allows for easier plans and specification creation once the restoration area is delineated.

The installation procedures for the plantings should follow the guidelines stated in the coastal sage scrub experiment, depending upon the irrigation procedure chosen.

MAINTENANCE

Maintenance will consist of irrigation and weed control during a 2-3 year plant establishment period. Irrigation can be tapered off every year such that in the second year irrigation is 50% less frequent, and in the third possibly not at all. But this must be field-fit to inter-annual variability in the weather and the growth of the plantings (see monitoring below).

The site preparation techniques proposed (wood chip mulch, seeding, mycorrhizal inoculation) should reduce weed growth and weeding requirements. However, be prepared to perform some weeding in the restoration area as needed. The irrigation basins should be kept weed free by manual removal. Weeds should be kept to a height of less than 2 feet in the space between planting by weed-whacking. Weeds should not be allowed to set seed before removal. If the weeds have not gone to seed, the debris should be left on-site.

The irrigation system should be inspected regularly. Any damage should be repaired as soon as possible not only for water conservation reasons but also for the coastal sage scrub community susceptibility to water-logging induced mortality. The planting basins should be repaired as needed, as well as the mulch replenished for the first three years.

MONITORING

Overview

The purpose of the restoration site monitoring proposed below is to track vegetation establishment, assess the degree of revegetation success, and provide a basis for adaptive management recommendations for the Bayview site. The monitoring program should have a duration of at least 5 years following the installation. This allows two years of monitoring after the cessation of regular maintenance in Year-3 to determine if the target habitats are self-sustainable without maintenance (irrigation, weed control and replanting). Monitoring will consist of frequent qualitative site assessments and annual quantitative vegetation monitoring.

Qualitative Site Monitoring

Qualitative site assessments should be conducted at least once every two months. The purpose of these assessments is to assess the overall performance of the vegetation and to determine site maintenance requirements. Assessment of the following factors will be made during site visits:

- Vegetation establishment with special attention paid to areas lacking vegetation
- Mortality of planted shrubs and trees
- Plant species composition
- Irrigation and maintenance of planted trees and shrubs
- Invasion of revegetation site by non-native, invasive weeds

Annual Quantitative Monitoring

Quantitative annual monitoring should be performed in April-May (before the sage scrub species go dormant in the summer) during the first 5 years following plant installation. Site visits will be conducted to assess site conditions and the establishment of vegetation throughout the project site. Percent survival and percent vegetative cover by species should be quantified.

Monitoring Methods

Percent Survival. In Years 1, 2, and 3, the percent survival by species will be determined. All live individuals should be tallied by species. Percent survival is calculated as follows: (Number Alive Species A/Number Originally Planted Species A) * 100 Percent survival should be calculated by species and for all species combined within the target habitat types (e.g. high salt marsh, ecotone, coastal sage scrub). If the percent survival falls below 100% in Years 1 and 2 or 80% in Year 3, all dead plants should be replanted. Species observed to perform well should be utilized to replace the dead individuals.

Percent Vegetative Cover. Percent cover is a good measure of vegetation establishment and plant community composition. Therefore, the percent vegetative cover should be quantitatively monitored in Years 1, 2, 3, 4, and 5 to track the development of the vegetation.

Permanent, 100-foot long transects should be established at random locations throughout the three target plant associations (high salt marsh, ecotone, coastal sage scrub). The endpoints of each transect will be marked in the field with metal t-posts or metal u-posts. Percent vegetative

cover by species (herbaceous species may be lumped into one category) should be measured annually, using the line-intercept method (Bonham 1989) from the same permanently-marked transects. The number of transects should be determined by evaluating the average total vegetation cover value obtained over increasing numbers of transects. The number of transects used should be the point where additional samples do not substantially change the average cover value obtained (Kershaw 1973).

The average percent cover will be calculated by species for each of the three target habitat areas (high salt marsh, ecotone, coastal sage scrub). The total native and non-native species cover should also be calculated by habitat type.

FIRE MANAGEMENT OF COASTAL SAGE SCRUB HABITAT

It is desirable for restoration projects to have no long-term maintenance requirements, and in a natural setting that would be the case for coastal sage scrub restoration. However, at the urban interface coastal sage scrub may require long-term maintenance in order to prevent fire hazards. Coastal sage scrub fire management methods are presented in much more detail in Ainsworth and Doss (1995, and citations found therein). Below is a brief summary of fire ecology as it related to coastal sage scrub.

It has been shown through much research that coastal sage scrub has evolved with periodic burning. Fire is essential for:

1) Several coastal sage scrub species' reproduction (flowering, seed germination/dispersal),
2) Several coastal sage scrub species' growth (bud production, sprouting),
3) Increasing available sunlight for sprouting (overstory and litter),
4) Creating a seedbed of bare mineral soil,
5) Increasing available nutrients from burnt vegetation,
6) Increasing available nutrients due to nitrogen-fixing annuals,
7) Reduction of erosion and debris flows with cooler fires,
8) Creation of a hydrophobic layer in the soil to increase moisture retention,
9) Reduction of the community fuel load so burns are cooler/less destructive,
10) Reduction in fire hazard for surrounding habitats (including developed).

Fire induces germination in the seedbank by scarifying the seed coat and increasing nutrients and sunlight. Fast growing annual composites (flowers) and perennial grasses dominate the clearing for the first several years. These species are known nitrogen fixers, and replenish the soil with the inorganic nutrients released by the burn. They may even give a boost to the mycorrhizal community by increasing their habitat (root systems of some plants in soil).

By year 4 or 5 post-burn, the woody perennials begin to dominate the area again. By year 10 the woody perennial community will have matured. By year-20, the fuel load in the area will have reached a level where the cooler wildfires begin to occur. And if fire suppression tactics are performed, sometime between years 40 and 60 the fuel load will be so high that accidental fires will be uncontrollable, and the hotter firestorms will threaten both the coastal sage scrub community and surrounding habitats (including developed).

Coastal sage scrub communities are estimated to burn in uncontrolled wildlands every 20-40 years. These natural burns are predominantly slow, cooler burns because fuel levels are still low. The firestorms so well publicized in Southern California were attributed to decades of fire suppression. These suppression tactics allowed fuel loads to get so high that firestorms were created. These firestorms are detrimental to coastal sage scrub communities as well as surrounding communities (including developed areas).

The complications involved in prescribed burns seem prohibitive, especially when justified only by the ecological needs of a natural community. However, this management regime may seem

less prohibitive with the knowledge that the very controllable prescribed burns will eliminate a known uncontrollable fire hazard.

Therefore, we recommend that you create a collaboration among the local agencies and the surrounding communities and draft a prescribed burn management plan. Based upon the information reviewed for this document, these prescribed burns should occur approximately every 20 years to eliminate the possibility of excessive fuel loads. The burns should not include the entire habitat, but should be carried out in smaller areas. This creates a mosaic of uneven-aged stands of coastal sage scrub that are considered the most productive, diverse, and fire retardant.

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APPENDIX A:
SPECIES PLANTING PALETTES

Table 1. Seed Species Recommended for Site Preparation.

Type	Scientific Name	Common Name
Grass	Nassella pulchra	purple needlegrass
Grass	Nassella lepida	foothill needlegrass
Grass	Achnetherum coronatum	needlegrass
Grass	Danthonia californica	California oatgrass
Grass	Leymus condensatus	giant rye-grass
Grass	Elymus glaucus	blue wild-rye
Grass	Poa secunda	bluegrass
Grass	Melica imperfecta	melicgrass
Grass	Bromus carinatus	California brome
Forb	Eschscholzia californica	California poppy
Forb	Dichelostemma capitatum	bluedick
Forb	Calochortus sp. (7 locals)	mariposa lilys
Forb	Lupinus sp. (18 locals)	lupines
Forb	Lasthenia californica	
Forb	Sisyrinchium bellum	blue eyed grass
Forb	Allium sp. (10 locals)	wild onions
Forb	Coreopsis sp. (5 locals)	tickseeds
Forb	Lasthenia sp. (3 locals)	goldfields
Forb	Aristida purpurea	purple three-awn
Forb	Epilobium sp. (4 locals)	fireweeds
Forb	Linum lewisii	Lewis' flax
Forb	Monardella sp. (4 locals)	monardellas
Forb	Penstemon sp. (3 locals)	penstemons
Forb	Ambrosia sp. (9 locals)	ragweeds

Note: Check Jepson Manual for locals (South Coast Ecoregion) and their native status. Check with supplier (i.e. S&S Seeds) for recommended broadcast rates. Grasses and forbs should be split 50/50 in the final seed mix.

Table 2. Plant Palette Recommended for the High Marsh Community.

Scientific Name	Common Name	On-Center Spacing (feet)	Container	% of Community
Frankenia salina	alkali heath	3	supercell	20
Salicornia subterminalis	perennial glasswort	3	supercell	15
Distichlis spicata	saltgrass	3	treeband	25
Atriplex lentiformis	salt bush	5	deepot	10
Cressa truxillensis	alkali weed	1	treeband	10
Salicornia virginica	common pickleweed	3	supercell	10
Limonium californicum	sea lavender	3	treeband	5
Monanthochloe littoralis	shore grass	3	treeband	5
Grindelia sp. (4 locals)	marsh gumplants	3	deepot	5

Note: Check Jepson Manual for locals (South Coast Ecoregion) and their native status.

Table 3. Plantings Recommended for the Coastal Sage Scrub Restoration.

Growth Form	Latin Name	Common Name	On-Center Spacing (feet)	Container Type	Alternate Container	% of Community
Shrub	*Artemisia californica*	California sagebrush	5	dee pots	1-gallon	20
Shrub	*Salvia mellifera*	black sage	5	dee pots	1-gallon	10
Shrub	*Encelia californica*	California encelia	5	dee pots	1-gallon	10
Shrub	*Eriogonum fasciculatum*	California buckwheat	5	dee pots	1-gallon	10
Succulent	*Opuntia littoralis*	coast prickly-pear	3	1-gallon	cuttings	5
Shrub	*Isomeris arborea*	bladderpod	5	dee pots	1-gallon	10
Sub-shrub	*Isocoma menziesii*	coast goldenbush	5	dee pots	1-gallon	5
Sub-shrub	*Lotus scoparius*	deer weed	5	dee pots	1-gallon	5
Succulent	*Agave shawii*	Shaw agave	50	1-gallon	cuttings	5
Succulent	*Opuntia oricola*	tree prickly-pear	50	1-gallon	cuttings	5
Shrub	*Rhus integrifolia*	lemonade berry	50	tree pots	1-gallon	5
Shrub	*Euphorbia misera*	cliff spurge	5	dee pots	1-gallon	rare
Sub-shrub	*Mirabilis californica*	wishbone bush	5	dee pots	1-gallon	rare
Shrub	*Lycium* sp. (4 locals)	box-thorns	5	dee pots	1-gallon	rare
Shrub	*Mimulus longiflorus*	bush monkeyflower	5	dee pots	1-gallon	rare
Succulent	*Dudleya* sp. (14 locals)	dudleyas	50	1-gallon	cuttings	rare
Succulent	*Opuntia prolifera*	bluff cholla	50	1-gallon	cuttings	rare
Tree	*Sambucus mexicana*	mexican elderberry	50	tree pots	1-gallon	rare
Tree	*Quercus agrifolia*	coast live oak	rare	tree pots	5-gallon	rare

Note: Check Jepson Manual for locals (South Coast Ecoregion) and their native status.

APPENDIX B:
INVASIVE SPECIES ERADICATION INFORMATION

Giant Reed (*Arundo donax*) (from H. T. Harvey & Associates, 2000)

Eradication of large infestations of giant reed would typically require the use of heavy equipment as well as the use of an herbicide, such as Aquamaster (formerly called Rodeo), that is approved for use in aquatic settings. Once the giant reed is eliminated, the newly exposed areas will need to be planted with appropriate native species to help exclude future infestations.

Manual removal of giant reed and stem application of herbicides will work for smaller, more isolated stands. This treatment entails cutting the stems of giant reed approximately 2 feet above the existing grade, and immediately applying concentrated herbicide (Aquamaster) directly to the cut stems. This method is most effective post-flowering (usually mid-August) when the plants are actively translocating nutrients to the root mass. Extensive cleaning and raking must accompany the removal of giant reed, as new plants can re-sprout from cut material. All stems must be hauled off-site and disposed of at a landfill. This method typically requires multiple years of treatment to ensure that the root mass is dead. Treatment in subsequent years will take place in late summer and will entail the manual removal of any new giant reed growth and the re-application of herbicides. Alternatively, the leaves of new re-sprouts can be sprayed without cutting the stems.

If it is necessary to utilize heavy equipment to mechanically remove larger, more accessible stands of giant reed, care must be taken to ensure sensitive habitats are not disturbed. Access routes should be carefully selected, resource agency approval obtained, and the seasonal timing of operations limited to the dry season. Care must also be taken around any known archaeologically sensitive areas.

For such a program to be successful it would be necessary for the eradication zone to commence at the upstream end of the area, since giant reed can easily re-establish from upstream sources. The seed of giant reed is infertile in the San Francisco Bay area and may also be in UNB. Thus, the plant may have difficulty colonizing in an upstream direction. It will be necessary to remove all stands of the reed to avoid migration of stands, even laterally. With all of the removal techniques, it is imperative that all portions of the removed plant (especially the stems and rhizomes) be disposed of at a landfill.

Lollypop Tree or Ngaio Tree (*Myoporum laetum*)

Lollypop tree should be cut as close to the ground as possible. Immediately after cutting, an herbicide such as Aquamaster should be applied with either a paintbrush or a squirt bottle directly upon the stump. Any delay will diminish the effectiveness of the herbicide. To ensure complete treatment, a biodegradable dye should be added to the herbicide, so treatment can be tracked.

Mustards (*Brassica rapa* or *B. nigra*)

Removal methods for mustards are covered in the coastal sage scrub experiment section.

Hottentot Sea Fig or Chilean Sea Fig (*Carpobrotus edulis* or *C. chilensis*)

Client is already utilizing a successful method. This method involves covering the infested area with a black plastic tarp for 6-8 weeks.

APPENDIX C:
ANNUAL SCHEDULE FOR HABITAT RESTORATION ACTIVITIES

Appendix C. Seasonal Schedule for Habitat Restoration Activities*

Task	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug
COASTAL SAGE SCRUB (CSS)/SALTMARSH RESTORATION												
Propagule Collection for Nursery Propagation (Approximately 8 months growing time required after collection)	■	■	■	■	■	■						
Site Preparation - Weed Removal	■	■										■
Site Preparation - Imprinting/Seeding			■	■	■							
Container Plant Installation			■	■	■							
Maintenance-Irrigation (2-3 year duration)	■	■						■	■	■	■	■
Maintenance - Weed Control (2-3 year duration)		■		■		■		■		■		■
Monitoring - Qualitative Assessments	■		■		■		■		■		■	
Monitoring - Quantitative - Percent Survival, Crown Volume and Percent Cover									■	■		
RIPARIAN (WILLOW) RESTORATION												
Harvest Willow Stakes, Posts, and Poles					■	■						
Install Willow Stakes, Posts, and Poles					■	■						
Install Groundwater Monitoring Dipwells					■	■	■					
Maintenance - Weed Control (2-3 year duration)		■		■		■		■		■		■
Monitoring - Percent Survival, Height, and Groundwater Depth	■		■		■			■			■	

* Note: This is a generalized schedule for the timing of habitat restoration activities proposed in this Restoration Plan. The best timing and appropriate duration of a given task may vary from this idealized schedule depending on site- specific climatic conditions, soil conditions and plant species.

APPENDIX C

Funding Resources

Funding Resources

This appendix lists a range of websites to help you identify funding sources and other resources for your project. It is not intended to be a comprehensive list of resources, but will help get you started. Our main focus is grants. For the most part, we do not list individual grant sources – there are too many to list here, and the list would soon be out of date. The websites listed here will point you in the direction of individual grants, grantmakers, other funding sources, and other resources that fit your project needs.

SOUTHERN CALIFORNIA WETLANDS RECOVERY PROJECT
www.scwrp.org

The SCWRP is an important resource for individuals and organizations interested in wetlands restoration in southern California (from San Diego to Santa Barbara County) and elsewhere. SCWRP offers a Community Wetland Restoration Grants Program, and numerous other resources. Its website includes an extensive list of local (by county), state, and federal wetland grant programs. Whereas the local grants apply to southern California counties only, most of grants in the state and federal lists are relevant to projects throughout California. The "local" section includes small foundations, major landowners, and corporations, as well as local mitigation funding. This website also has a list of education and training resources.

SAN FRANCISCO BAY JOINT VENTURE
www.sfbayjv.org

The SFBJV offers a variety of resources for individuals and organizations working on restoring habitat in and around San Francisco Bay – wetlands, riparian, and associated upland habitat. It has an on-line newsletter that includes information on funding opportunities, upcoming events and conferences, and new resources. The website's funding section lists grants and other funding opportunities at the federal, state and local level.

Idealist.org

Idealist.org is a website where "people and organizations can exchange resources and ideas, and locate opportunities and supporters." The website has an online Resources Center called "Tools for Organizations," with links to a variety of fundraising tools and non-profit support organizations.

WHALE TAIL GRANTS PROGRAM
www.coast4u.org

The California Coastal Commission administers a grants program that is funded by sales of the Whale Tail License Plate. The grants support programs that teach California's children and the general public to value and take action to improve the health of the state's marine and coastal resources, including coastal habitat restoration projects. This grants program focuses on reaching communities that are currently poorly served in terms of marine and coastal education.

THE FOUNDATION CENTER
www.foundationcenter.org

The Foundation Center helps grantseekers find potential foundation grants and corporate donations. The website offers a wealth of information for non-profits, including grants databases, on-line training, and other resources. It also has a number of offices where grantseekers can go to use their libraries and on-line services in cities across the U.S. In California, there is a Foundation Center in San Francisco, as well as affiliated centers and libraries that provide some of the same core services across the state.

THE GRANTSMANSHIP CENTER
www.tgci.com

The Grantsmanship Centers offers workshops in grantsmanship training and earned income strategies for non-profits. There are also a number of resources for grantseekers available at no cost on tgci.com. These include daily grant announcements from the Federal Register, and indexes of funding sources.

Grants.gov

The grants.gov website is a central source of information on hundreds of grants programs available from the federal government. It can be searched by different categories including the Environment. Different funding opportunities are listed from various agencies, including those supporting habitat restoration such as the U.S. Fish and Wildlife Service and NOAA. Grant proposals may be submitted electronically from this site.

U. S. ENVIRONMENTAL PROTECTION AGENCY
www.epa.gov/owow/

The U. S. EPA Wetlands, Oceans, and Watersheds website offers a number of resources for community-based restoration programs, including a whole page of links to various funding databases – most are searchable. (www.epa.gov/owow/funding/databases.html)

APPENDIX D

Sample Project Application Form

Date:

Department of Fish and Game
Project Application Form

Name of Individual or Group: Kristina Finstad, UNB Restoration Education Project Coordinator

Contact Number: (949) 640-0286

Address: 600 Shellmaker Drive, Newport Beach, 92660

Project Title: Planting Bayview Solar Plots II

Objectives: Install natives on two solarized plots at the Bayview restoration site to promote native wildlife.

Project Description: DFG and CCC tools (gloves, shovels, plants) will be transported to site in the DFG pick-up truck. The DFG water bladder and buckets will be transported in DFG stake-side truck. Approximately 50 volunteers will walk from the Interpretive Center to the Bayview site.

Two 10'x20' plots, solarized July-August (see July 2 2004 Project Approval), will be watered and planted. In compacted soils, holes will be augered by Tom Fox. Other holes will be dug by voluteers, disturbing the soil as little as possible. A teaspoon of mycorrhizal innoculum will be added to the bottom of each planting hole. Mulch will be applied at three-inch depth within the plots. Container plants have been grown in the UNB nursery, using UNB seeds. A total of 40 plants will be installed, 20 plants in each plot. Five species will be used: sagebrush, bush sunflower, bladderpod, everlasting, and buckwheat. Planting methods:

1. **Dig a hole twice as deep and wide as the container**
2. **Fill hole with water and allow to drain**
3. **Remove plant from container and loosen bound roots**
4. **Install plant with root crown slightly above ground level**
5. **Back fill hole with soil and lightly compact to eliminate air spaces**
6. **Build an irrigation basin with a three-inch high earthen berm to retain water**
7. **Cover basin bottom with a two-inch layer of mulch**
8. **Irrigate basin with four gallons of water**

See attached plant list for species and quantity information.

Bayview west plots will also be watered, one gallon per plant.

Project Location: Bayview Trail, in between San Diego Creek and Delhi Channel, near to the intersection of Mesa Drive and UNBNP, on the bay side of the path. From the Interpretive Center, walk eastward, over bridge, about .5 miles.

Timeline: Planting and watering is proposed for September 25, 2004 from 9-12. Solarization began July 24, 2004. Seeding will be done after first rains.

Monitoring Plan: Maintenance will consist of irrigation and weed control during a 2-3 year plant establishment period. One gallon of water will be applied per plant per irrigation event. During Year 1, plants will be watered 1 time per month in December-March, 2 times per month in April-August, and 1 time in September-November. During Year 2, plants will not be watered December - March. Irrigation can be tapered off such that second year irrigation is 50% less frequent, and in the thrid possibly not at all. Qualitative site assessments will be conducted once every 2 months. Assessment of the following factors will be made during site visits: vegetation establishment, mortality, species composition, irrigation and maintenance, and invasion by non-natives. Quantitative annual monitoring will be done in April-May during the first 5 years. Percent survival and percent vegetative cover will be measured.

All parties involved in activities taking place on Fish and Game property will be required to sign up as a volunteer of the California Department of Fish & Game. A copy of this letter is to be carried at all times by the project coordinato while within the Ecological Reserve.

Approved By: _____
Title: _____
Date: ____/____/____

Instructions for Project Application Form

Name of Individual: State identity of applicant(s).

Project Title: Please give your project a name. Be creative!

Objectives: Describe the purpose of your project. List the desired outcomes.

Project Description: Describe the project in detail. Discuss the tools, methodology, materials, and personnel involved. If you plan to be planting, please include plant species being used. If you plan to remove vegetation, please list species being removed and plans for disposal.

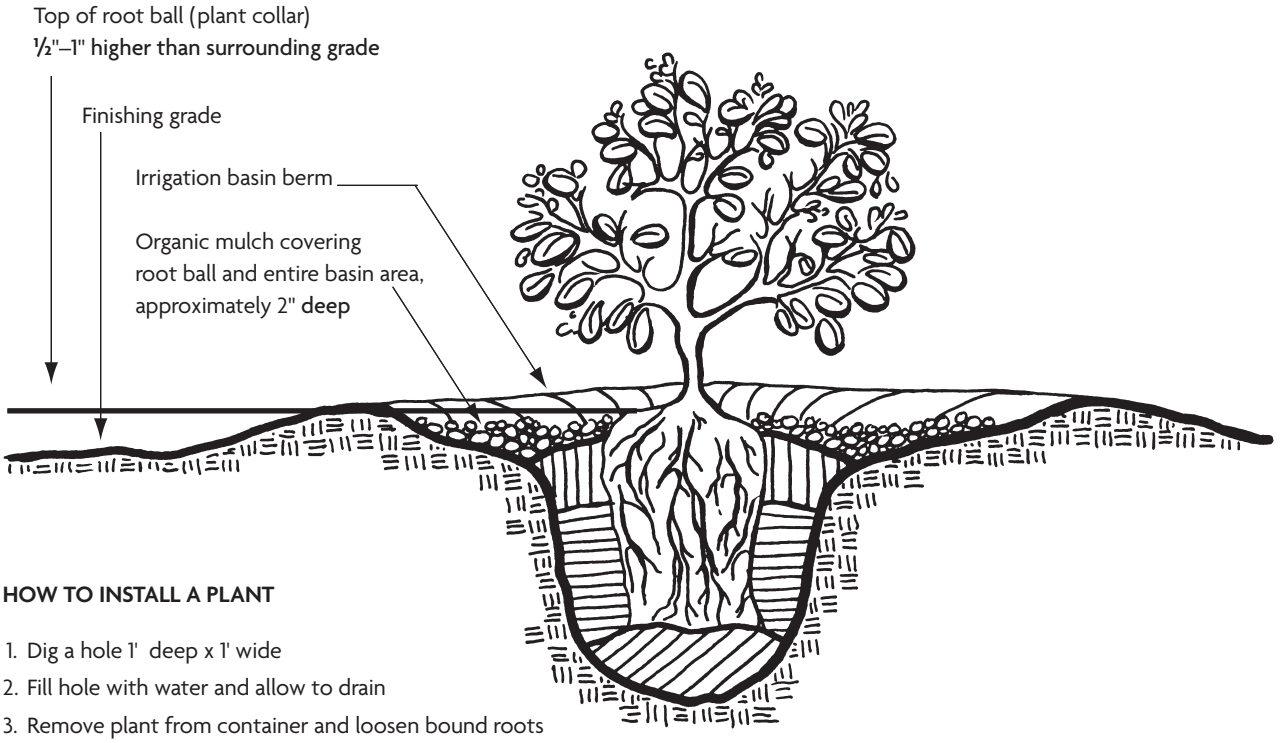
Project Location: Describe the physical setting. Name cross-streets, island names, or mile markers collected from the odometer. Include a map when possible.

Timeline: State expected start date and completion date. Include hours of the day also.

Monitoring plan: Describe plans to monitor the project for success. Discuss any subsequent visits required for maintenance.

APPENDIX E

Steps to Install a Plant



HOW TO INSTALL A PLANT

1. Dig a hole 1' deep x 1' wide
2. Fill hole with water and allow to drain
3. Remove plant from container and loosen bound roots
4. Install plant with root crown slightly above existing grade
5. Back fill hole with soil and lightly compact to eliminate air spcaes
6. Build an irrigation basin with a 3" high estern berm
7. Cover basin bottom and berm with a 2" layer of mulch
8. Irrigate basin with 4 gallons of water

APPENDIX F

Sample Monitoring Plan

1.0 PROJECT DESCRIPTION

1.1 Responsible Parties

The Upper Newport Bay (UNB) Community-Based Restoration Education Program (CBREP) is a team effort involving: the California Coastal Commission (CCC); California Department of Fish and Game (CDFG); Orange County Harbors, Beaches, and Parks (OCHPB); and the Newport Bay Naturalists and Friends. The lead agency is the CCC.

1.1.1 Ownership Status

The California Department of Fish and Game manages 740 acres of wetlands in the UNB. OCHPB manages 140 acres of surrounding bluffs.

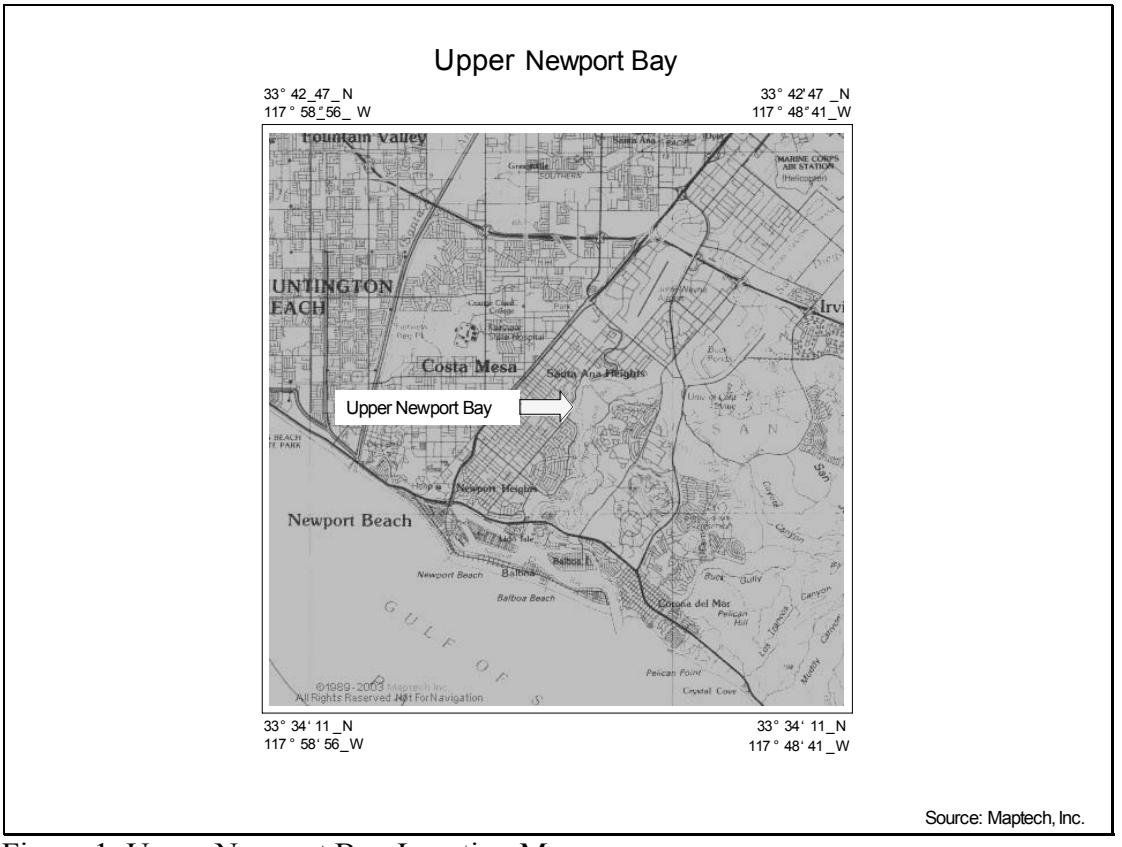
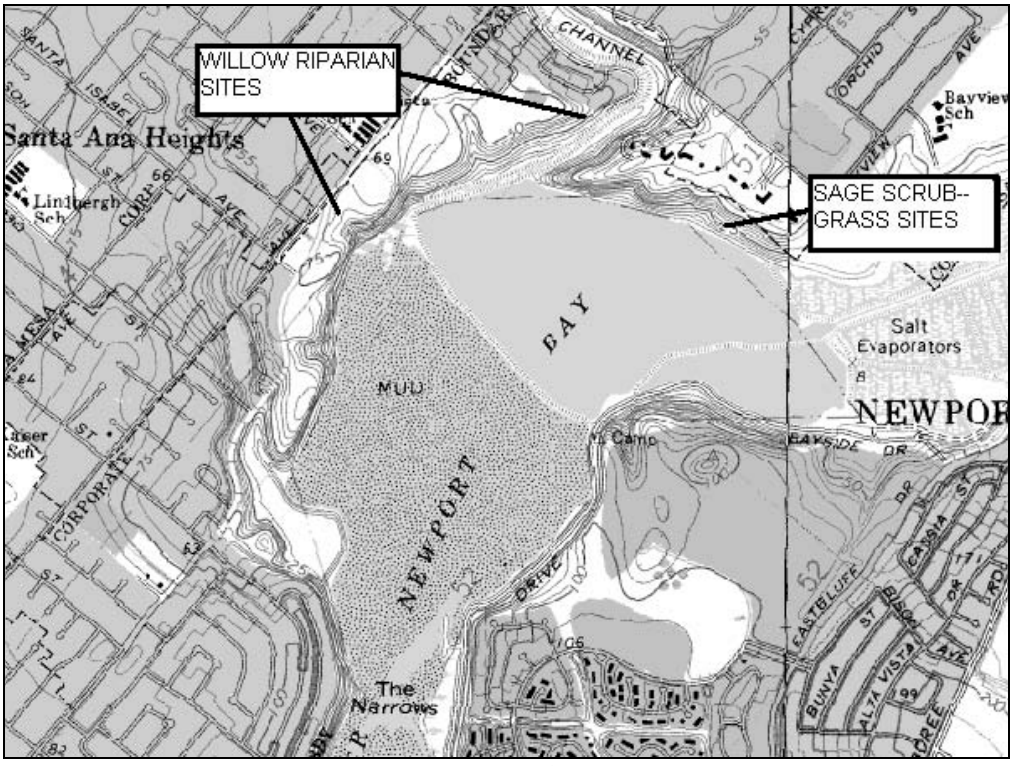


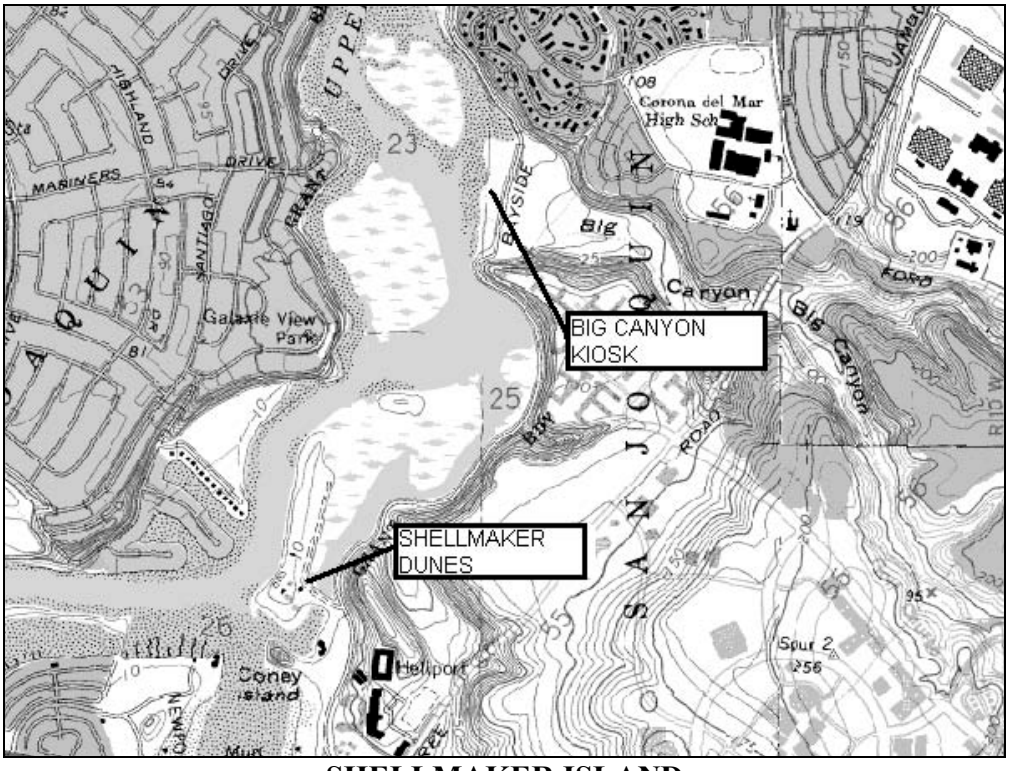
Figure 1: Upper Newport Bay-Location Map

1.2 Location of Project

Newport Bay is a coastal estuary located in Orange County, California (Figure1). The mouth of Newport Bay is in the city of Newport Beach and the Bay extends inland for approximately 6 miles. The project area is located in Upper Newport Bay. Upper Newport Bay extends from the Pacific Coast Highway (State Route 1) Bridge up to Jamboree Road Bridge.



UPPER NEWPORT BAY



SHELLMAKER ISLAND

Figure 2: Restoration Sites- Location Map

1.3 Summary of Overall Project

With an estimated 97 percent of coastal wetlands in southern California lost to development and agriculture, UNB is one of the largest remaining intact areas supporting a wide array of plant and animal life. The Upper Newport Bay Nature Preserve and Ecological Reserve comprise approximately 1,000 acres of open space, including 200 feet of stream corridor and 784 acres of wetland. It is home to 165 different species of birds, seven of which are rare or endangered: Light Footed Clapper Rail, Brown Pelican, Belding's Savannah Sparrow, Black Rail, Peregrine Falcon, California Least Tern, and Black-tailed Gnatcatcher. The Reserve is also home to rare and endangered plant species including Saltmarsh Bird's Beak, Southern Tarplant, Laguna Live-Forever, Estuary Seablite, and Wooly-Heads.

This critical and sensitive environment is threatened by factors that include: 1) extensive development that has encroached on UNB and 2) human activity disturbing much of the adjacent undeveloped land. Non-native species now make up 48 percent of the plant population at UNB. Preventing further degradation and protecting the vitality of the diverse native bird and plant populations of UNB requires restoration of this wetland ecosystem.

The CBREP is a community-based habitat restoration project. The CBREP promotes community involvement with an education program designed to teach the importance of habitat restoration and by offering the public an opportunity to become involved in hands-on restoration work. By mobilizing community involvement and volunteer labor, the CBREP will address the degradation of UNB through: eradication of invasive plant species, restoration, maintenance, and monitoring of selected restoration sites and the surrounding area.

In 2002, the CCC secured the services of H.T. Harvey & Associates to prepare a restoration plan for three select sites in UNB (Figure 2). These sites are accessible from the Peter & Mary Muth Interpretive Center(IC). They are: 1) Coastal Sage Scrub Restoration Experiment Site; 2) Willow Riparian Restoration Sites I & II; and 3) Bayview Restoration Site. In addition to the sites selected by H.T. Harvey, two other sites have been deemed appropriate for restoration by Kristina Finstad, Restoration Education Project Coordinator for the CCC. These sites are Big Canyon Kiosk Garden and Shellmaker Dunes (Figure 2).

1.3.1 Project Goals

The CBREP seeks to protect and enhance habitat for wildlife, including endangered species, and provide unique scientific and educational opportunities to study the restoration of a wetland community. It is important to the viability of UNB that local residents, community groups, and young people understand the value of the wetland and surrounding uplands and how they can help conserve it and keep it healthy. Restoration work is conducted with the participation of community volunteers and students. Volunteers may participate through either Steward Days (weekly events for native plant propagation and developing interpretive signs), Restoration Teamwork Events (monthly weed eradication and planting), and School Field Days (for restoration work by students).

After completing the activities prescribed in the Restoration Plan (H. T. Harvey &Associates) the following objectives will be met:

- Restore, monitor, and maintain 1 acre as willow-dominated riparian habitat.
- Restore, monitor, and maintain 0.5 acres of high salt marsh.
- Restore, monitor, and maintain 8.5 acres, converting it in phases to marsh/scrub ecotone and coastal sage scrub habitats.
- Remove non-native, invasive weeds on an additional 4.5 acres.

The CCC intends to continue to run the CBREP and conduct restoration, monitoring, and maintenance at UNB as part of an ongoing effort toward wetland restoration. Restoration efforts will be monitored to provide a model for future restoration projects. Volunteers will utilize a monitoring schedule (Appendix A) to help insure the success of the restoration and monitoring projects.

The completion of restoration goals will result in a 60% native species cover within 2-3 years and 80% native species cover with non-native relative cover of less than 10% within 5 years. After each Percentage of Cover monitoring event, a comparison will be made by the Project Coordinator of the current percent of cover relative to the 80% goal. The Project Coordinator will assess the comparative success of the restoration efforts and make adjustments to the restoration plan as needed.

1.4 Purpose of Monitoring Plan

The purpose of the monitoring plan is to involve the community in reaching the long-term goals designated in the restoration plan. The monitoring plan will be used as an educational tool that will allow students/volunteers to compare the restoration site to a similar reference site, to assess the success of the restoration, to evaluate the need for remediation, and to decide what form of remediation should be taken if needed.

The monitoring plan will also be used for the purpose of establishing baseline data for future projects. The baseline data can be used to make recommendations that may enhance the chances of success of future restoration sites and provide comparative value between sites.

1.5 Reference Site

A reference site typically covers about the same acreage as the restoration site and can be either similar to the restoration site or a target for the completed restoration. The reference site is monitored simultaneously with the restoration site and acts as a control plot. The reference site is compared with the restoration site to provide a control system by which environmental effects or human activities, unrelated to the restoration action, can be assessed. The comparative information can be used to determine if intervention is needed to compensate for some unpredicted variation between sites.
Using a reference site for a completion goal provides an arena in which to judge the success or failure of the restoration site. The restoration site can be assessed to determine if the percentage of cover and species diversity is proportionally increasing annually and will match the reference site within five years.

The use of a reference site as a goal may not be appropriate in all situations. It may be difficult to find an appropriate reference site in an area that has been heavily impacted by human activities. The disadvantage of an inappropriate reference site is that expected levels of performance for the restoration site may not be accurate, either too low or too high. Also, unforeseen future events may alter the restoration or reference sites rendering the performance standards inappropriate.

If an appropriate reference site cannot be found it may be better to use predetermined values for monitoring standards (example- % of cover achieved per year). The advantage of predetermined values is the potential reduction in overall monitoring (no reference site).

The Project Coordinator will determine if a reference site is available and appropriate for each restoration site. If a reference site is chosen a determination will be made as to the purpose of the reference site: a completion goal or control plot. The reference site will be monitored on the same schedule, using the same monitoring parameters, as the restoration site.

2.0 LANDSCAPE, SOIL, AND WATER QUALITY

2.1 Habitat Type

Upper Newport Bay is fringed with tidal salt marsh that historically would have been surrounded with a mixture of coastal sage scrub (soft chaparral) and grasslands. In addition, a diverse marsh assemblage of high salt marsh and coastal sage scrub species would have occurred historically in the transition zone (ecotone) between these wetland and upland habitats. Much of the upland habitat bordering the salt marshes of UNB has been disturbed by human activities and is dominated by ruderal species, such as field mustard (*Brassica rapa*), and invasive species, such as lollypop tree (M*yoporum laetum*) (H.T. Harvey, 2002).

In some specific locations, topography and anthropogenic influence has created concentrated freshwater runoff that supports riparian plant species including willow (S*alix* ssp.) (H.T. Harvey, 2002). The riparian habitat has been heavily impacted by human activity. Non-native species of grass and ruderal species such as *Arundo donax* dominate these locations.

2.2 Soil Analysis

The purpose of the soil analysis is to provide baseline data that will help insure the success of future restoration sites. A professional soil scientist, as arranged by the Restoration Education Project Coordinator, will complete the soil analysis. Soil samples will be taken prior to restoration plan implementation and bi-annually thereafter.

2.3 Water Quality

The Newport Bay Watershed drains a total of 154 square miles (98,500 acres) of Orange County into the UNB. Rainfall averages approximately 12 inches per year. 90% of the annual rainfall occurs between November and April, with minor precipitation during summer

months. In addition to precipitation, the Santa Isabel Channel Site and the Willow Riparian Site (Figure 2) receive waters from urban runoff that may contain non-point source pollutants.

Water quality can impact the success of these restoration projects. Degraded water quality can lead to an invasion of non-natives species of flora as well as the proliferation of pollution tolerant species of biota. Therefore, a water quality monitoring program will be considered an important part of the restoration monitoring plan. The water quality monitoring program will be administered by a qualified intern/volunteer with previous experience in monitoring, training, and program management. Water quality monitoring will be conducted monthly (see Appendix A) from November through June.

The EPA has developed a monitoring program to standardize the collection of water quality data in stream ecosystems impacted by non-point source pollution. The program, Rapid Bio-Assessment Protocol (RBP), is intended to simplify the monitoring process for non-professional volunteers and ecologists. The RBP is used as a guideline to document/analyze various biological, chemical, and physical characteristics of a stream ecosystem.

Volunteers will monitor only the physical and chemical characteristics of the riparian areas. Although biological assessments (macro-invertebrates) are a valuable tool for stream assessment, they can be relatively expensive, time consuming, and requires volunteers with knowledge of macro-invertebrates. One of several local non-profit organizations may agree to do a biological assessment in the restoration areas but their study will be conducted independent of volunteer efforts.

2.3.1 Physical Characteristics Assessment

The Riparian Characteristics Assessment Form (Appendix B1) will be used to record both qualitative and quantitative measurements at Santa Isabel Channel Site and Willow Riparian Restoration Site (Figure 2). There will be two monitoring sites within each restoration area. Work will always be conducted at the downstream site first so as not to impact the quality of the other site. The site should consist of a section of riffle (no ponds) at least five yards long.

The Project Coordinator will randomly select the sites using a bag of numbered chips that represents the number of riffles within the restoration site. After two riffles have been selected, mark a Baseline the length of each monitoring site (see Section 4.3.1 *Transect Placement*). The upstream and downstream end of the monitoring sites (riffles) will be staked for future identification. Photo points will be selected, documented, and marked at each monitoring site. Supplies for this project include:

- Three team members
- Tape measure/Measuring stick
- Rubber boots
- Reference stacks
- Thermometer
- Stopwatch
- Compass

- 120 ml Turbidity tube
- PingPong ball/Orange peel
- Densitometer/Steel can
- Pencils/Clipboard
- Riparian Characteristics Assessment Form
- Riparian Characteristics Results Form
- Camera

Both air and water temperature will be taken prior to sampling. Date, time, wind condition, and cloud cover will be noted. The testing area is assessed for debris content (paper, solid, toxic, etc.), percentage of algae coverage (within one square yard at each transect), substrate composition, and water surface condition (foamy, oily, etc.). Turbidity will be measured using a 120ml turbidity tube.

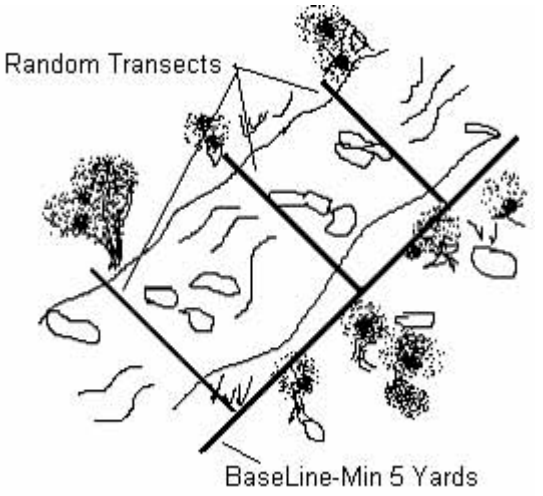


Figure 3. Placing Random Transects

At each of the two monitoring sites, three random transects will be marked (using a bag of numbered chips to represent marks on a tape measure stretched the length of the monitoring site. See Section 4.3.1 *Transect Placement*) and measured for the following:

Stream Width: Measured perpendicular to the waters flow from waters edge to waters edge. The average width at the three transects will be calculated to determine stream width.

Stream Depth: Measured using a ruler ¼ distance from the waters edge on each side of the stream and ½ distance from the waters edge. The total of these measurements is divided by four to account for the shallow water at the stream edge. The average depth at the three transects will be calculated to determine the stream depth.

Velocity: The equation to determine velocity involves the subjective estimation of channel bed roughness. For the purpose of this study, a float test will be conducted instead of using the equation (this test yields results that can only be used for comparative purposes). A five yard length will be measured alongside each riffle and a ping pong ball, or a piece of orange peel,

will be placed in the water upstream of the measured length. The time it takes the ball to travel five yards will be taken five times and averaged to determine velocity.

Percent of Canopy Cover: The percent of canopy cover will be calculated at the midpoint of the center transect. If one can be acquired, a densiometer will be used to measure canopy cover. One person will hold the densitometer, facing first east and then west, and estimate the percent of coverage in each square of the densitometer. Another team member will record the estimates. When both east and west facing counts are complete, the percentages for each square will be totaled and that number divided by the number of square counted.

If a densiometer cannot be acquired, an ocular tube will serve the same purpose. An ocular tube can be made by taping threads of monofilament line across a small, open ended steel can (Campbell's Soup). Percent of cover can be determined by looking directly overhead through the tube. Since square size is not accurate with this method, record whether there is a presence or absence of canopy cover where the threads cross, and then total, and divide the counts as above.

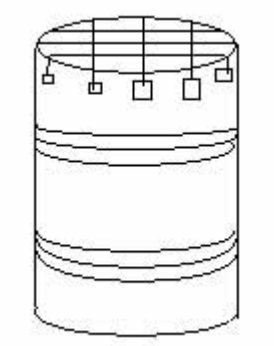


Figure 4. Example of a Homemade Densiometer.

2.3.2 Chemical Assessment

The chemical assessment will measure nitrogen, phosphorous, chlorine, dissolved oxygen, and pH levels in the water. Each monitoring site will be tested at the middle transect. Water at the testing site should be flowing steadily and not ponded. The pH can be measured using pH strips. All other chemical characteristics will be measured using CHEMets by CHEMetrics or other comparable testing kits. Test methods for each of these kits involve the use of breakaway ampoules, activator solutions, and comparators. Further information on the use of these kits can be obtained at www.chemetrics.com. Record all data on the Riparian Characteristics Assessment Form (Appendix B1).

3.0 RECORD OF INITIAL PLANTING EFFORTS

3.1 Recording Initial Planting Efforts

Recording initial planting efforts is crucial to the management of the restoration project. The project coordinator will need to evaluate the success of planting efforts and determine if mistakes were made and whether those mistakes need to be corrected.

After the initial planting is complete examine the site and document any problems with plants, seed germination, irrigation, erosion, vandalism, weed invasion, etc. that might adversely affect the success of restoration. Report any deviations in plant selections from the restoration plan. Use the instructions in Section 6.0 to establish the photo points for each restoration site. Photo document the visit. Record initial planting efforts on a Site Visit Form (Appendix B2).

3.2 As-Built Plans

As-built plans are drawings that represent the completed restoration project. They typically include plant location, seeding location, and irrigation fixtures. As-built plans are critical in the analysis of the success/failure of the restoration site. Upon completion of the initial planting, volunteers can create a set of as-built plans by means of a simple survey project. Photo document the site visit. The project will require:

- Three team members
- 100 Foot measuring tape
- 25 Foot measuring tape
- Compass
- 2 X 3 foot piece of vellum
- Engineers scale
- Circle template
- Data sheets and pencils
- Two 18” wooden stakes
- One bundle of 12” wooden stakes
- Mallet
- Pencils/Clipboard

Step One: Survey Methods

First, team members should estimate a point near the center of the restoration site. One team member will stand at that site and hold the 100 foot measuring tape. Another team member draws out the tape to the edge of the restoration plot and measures the distance. The third team member records the measurements. Take four measurements at the cardinal points of the compass (N, S, W, and E). Take four more measurements, at 45°, between these sites (NE, SE, NW, and SW). Using these measurements produce a scale drawing approximating the shape of each site on the 2 X 3 vellum.

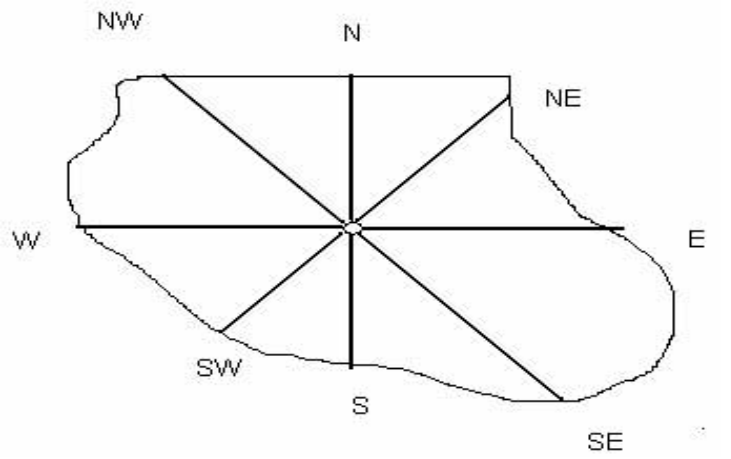


Figure 5. Approximating the shape of restoration sites.

Next, stake the two points on the perimeter of the restoration site that are farthest from each other using the 18" wooden stakes. Pick one as the starting point. Draw the tape measure from one stake to the other (For large plots this step will need repeating). Drive a stake at each 25 foot mark along the tape measure. This allows for easy identification when surveying vegetation.

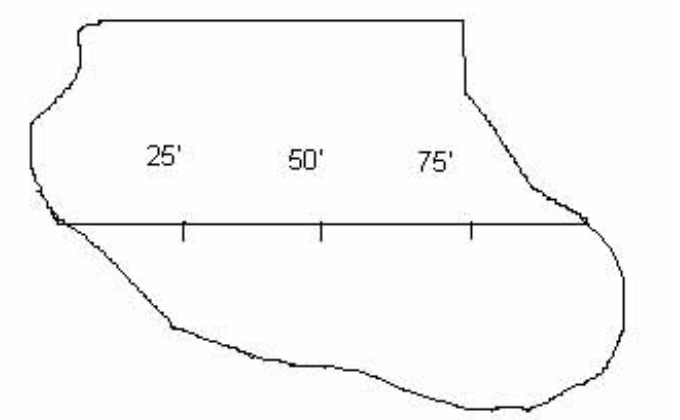


Figure 6. Place a stake every twenty five feet along tape.

Finally, one team member will hold the 100 ft tape while "walking" the line created in the step above. Lay the 25 foot measuring tape on the ground from 12" stake to 12" stake moving it forward as the walk proceeds 25ft tape helps "walker" locate his/her position on the line). At each foot mark the team member will look to the right and then to the left for plantings. When the "walker" is parallel with a planting, the second team member will draw out the 100 ft tape from the line to the stem/trunk of the planting, doing both the right and left side of the line. For example, at two feet the first team member identifies a planting to his/her left. The second team member draws the tape out to the stem/trunk of that planting and determines that the planting is 29 feet from the line. The third team member will record the measurements (see instructions below) and identify the planting. At sixteen feet, the first team member identifies a planting to his/her left and to the right. Both measurements are taken (13 ft to the right and 27 ft to the left) and the process continues down the line.

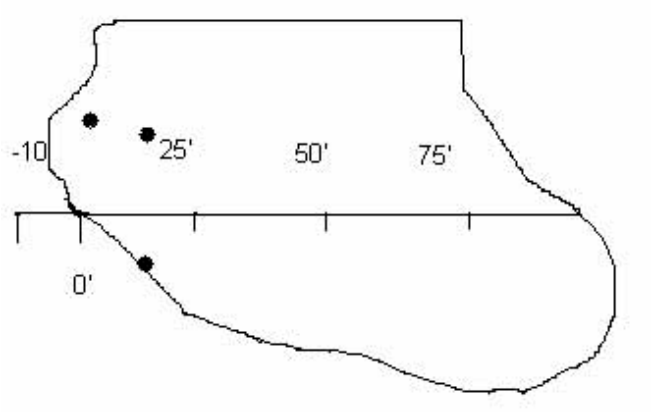


Figure 7. Location of plantings

Step Two: Recording the Measurements

The Plotting Form (Appendix B3) is used to record the location of each planting in the restoration site. Column 1 is used to record the point along the line at which the measurement was taken. For example, the first sighting above was taken at 02 feet, the second sighting was at 16 feet. Column 2 is used to record the measurement from the "line" to plantings on the left side. Column 3 is used to record the measurements on the right. Column 4 is for the common name of the planting. Column 5 corresponds to the pre-selected species number for the final as-built drawing (See Step Three: Plotting the Measurements).

PLOTTING FORM

FOOT MARK	LEFT OF LINE (FT)	RIGHT OF LINE (FT)	COMMON NAME	SPECIES NUMBER
02	29		Coast Live Oak	1
16	13		California Sagebrush	2
16		27	Coast Live Oak	1
98		6	California Buckwheat	3

Figure 8. Example of Plotting Form.

Step Three: Plotting the Measurement

The as-built plans will be completed using the information on the Plotting Form. Before starting, compile a list of the species of plantings used in the site. Alphabetize and number these names for reference purposes. Copy this list onto the top right hand corner of the vellum. On the vellum drawing mark the location of the 18" stakes and note which one is the starting point. Draw a line to connect the two stakes. Using hash marks indicate the location of the 12" stakes (every 25 feet) along the line.

Next, using the appropriate scale, plot the information from the plotting form. For the first entry, go up 02 feet and over 29 feet to the left and make dot. Using the template make a small circle around the dot. Inside the circle write the reference number for that species of planting. Repeat this step until all plantings are represented on the scale drawing.

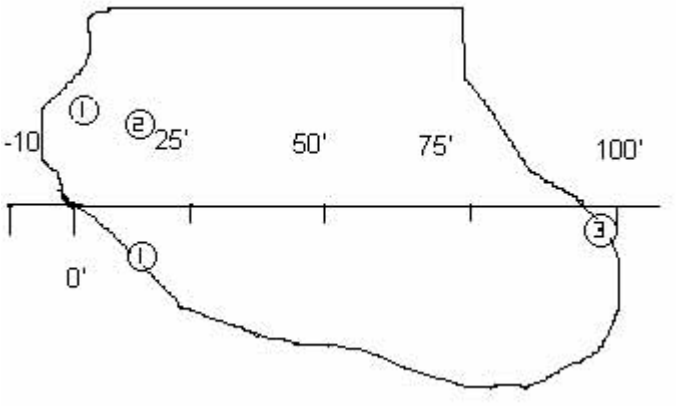


Figure 9. Example of as-built plans.

Once the plantings have been plotted, it should be relatively easy to outline the areas that were seeded. Differentiate these areas on the plans with parallel hatch marks. Add a legend to the as-built plans that defines the hatch mark areas. Add the location of any permanently installed sprinkler systems.

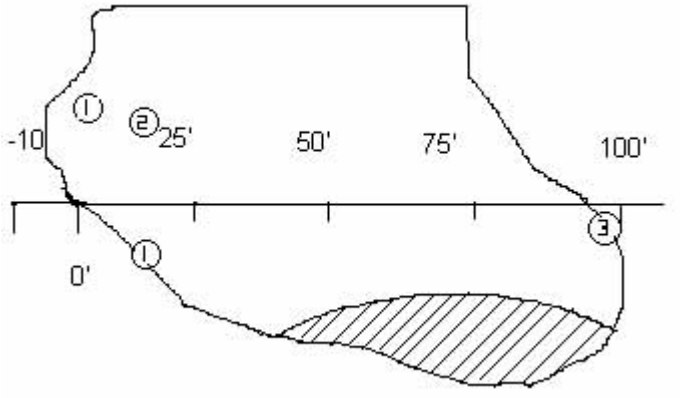


Figure 10. Parallel hatch marks representing seeded areas.

When complete, label the as-built plans with the name of the restoration site, name of project coordinator, the date, the scale, and a north arrow. Send the plans to a printer for paper copies. Attach the Record of Initial Planting Efforts and file.

4.0 VEGETATION MONITORING

The purpose of the vegetation monitoring program is to track vegetation establishment, assess the degree of the restoration program success, and provide a basis for adaptive management recommendations. The monitoring program will consist of several types of quantitative and qualitative measurements. These measurements will provide valuable data for future restoration projects and provide an opportunity for volunteers to experiment with different

monitoring methods. Volunteers will monitor: the number of plantings that survive; the percent of survival of all plantings; the size of individual plantings; the percentage of cover for native plants, non-native/ruderal plants, and substrates; seedling density; and the distribution of species. Refer to Appendix A for the monitoring schedule.

4.1 Number/Percentage of Survival of Container Plantings

The number/percentage of plants that survive the initial planting will be measured bi-monthly. Using the as-built plans as a reference, count the number of plantings of each species present within the restoration site. Count only original container plantings (flagged) and not seedlings or pre-existing plants. Record the counts on the Vegetation Monitoring Form (Appendix B4). Photo document the visit.

Use the total number of survivors for each species to calculate the percentage of survival. Percent survival is calculated as follows: Divide the total number of live plantings of species A by the number of original plantings of species A and multiply by 100 to obtain a percent. Record the percentage of survival on the Vegetation Monitoring From.

4.2 Size of Individual Plantings

During the bi-monthly visit all original container plantings will be measured for height and width and the data recorded on the Vegetation Monitoring Form. Use a tape measure, measuring stick, or telescoping survey rod (for willows) to measure the height at the point of the tallest living portion of the plant. Canopy depth will also be measured in riparian willow sites. To measure canopy depth, record the height of the lowest live branch and subtract from the measurement of the highest live branch. For riparian willow sites, measure five percent of the plantings and average the height and depth of the stand. Measure the width of ground level shrubs at their widest point.

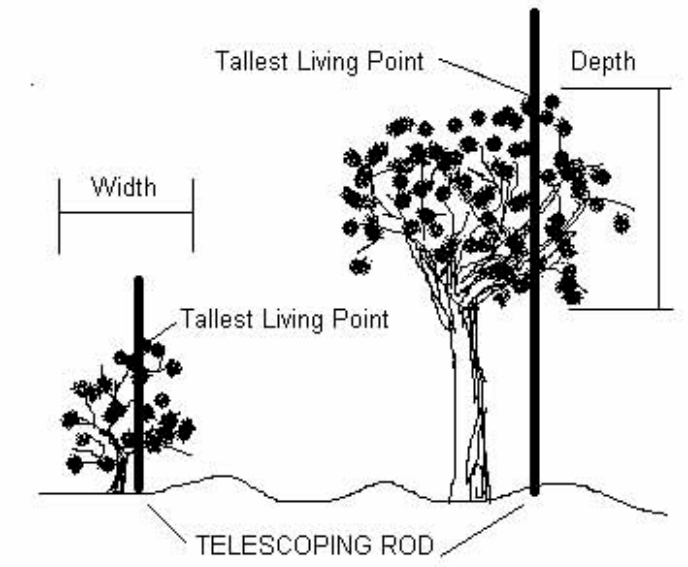


Figure 11. Measuring Height, Width, and Depth.

Measure only original plantings and not seedlings. For plants that have sprouted from runners off the original plantings volunteers will decide in the field what to count. If a cluster of plants is measured, make a note indicating the number of stems in the cluster.

4.3 Percentage of Cover-Monitoring Experiment

Ecologists are usually unable to measure the entire plant population of a restoration site. Instead they depend upon sampling techniques to reduce the number of measurements that must be taken. Volunteers will be utilizing sampling techniques in which they measure some of the plants at the restoration site and make inferences about all the plants at the site. The sampling technique will be:

1. Unbiased; the sample should be representative of the population as a whole.
2. Repeatable; it will be necessary to repeat the process semi-annually.
3. Feasible for volunteer use in the field.

For the purpose of this monitoring program volunteers will use two different sampling techniques to: 1) estimate the percent cover of plants; and 2) determine if sampling methodology affects estimates of populations. Volunteers will use an interrupted line-intercept method and a quadrant sampling method. Each group of volunteers will use both methods along the same transect and compare the results between the two methods. Percentage of cover monitoring events will take place from May-June each year.

4.3.1 Transect placement

A transect is the line in the field along which all plant counts will be conducted. When applicable, the transect should be oriented at right angles to the gradient and should start and finish well into the ecosystems on either side unless natural barriers determine the starting and finishing points. When riparian systems are studied the base stake should be placed at a convenient and easily recognizable boundary, like the high water mark. From this point the transect should go in both directions: to the water's edge, and in the opposite direction, well into a vegetative transition zone.

There are several standard methods for choosing the location of the transect lines.
The two methods below have been chosen for their ease of use and compatibility with the constraints of this project. Supplies needed for transect placement include:

- Copy of the as-built plans
- 100 foot tape measure
- Compass
- Eight permanent reference stakes (wood or metal)
- Mallet
- Table of random numbers/Bag of random numbered chips

Method One

On the copy of the as-built plans, draw a line (base line) parallel to a convenient boundary or natural feature, such as a ridge, or in a riparian area, the high water mark. The starting stake for each transect will be set on this line. From a table of random numbers (numbers representing the foot marks) or a bag of numbered chips, select four (4) points along the line as the starting locations for the transects. Reject any numbers that are not at least five yards apart. Use a compass and measuring tape to find the location of the specific starting points in the field and mark each with a permanent reference stake. Next, use the tape measure to establish four (4) transect lines perpendicular to the base line, using 25ft, 50ft, 75ft, or 100ft lines, whichever is appropriate for the restoration site. As mentioned above, in riparian areas, the transect will go in both directions from the base stake. Mark the end(s) of each transect with a reference stake. Mark the as-built plans with location of transects.

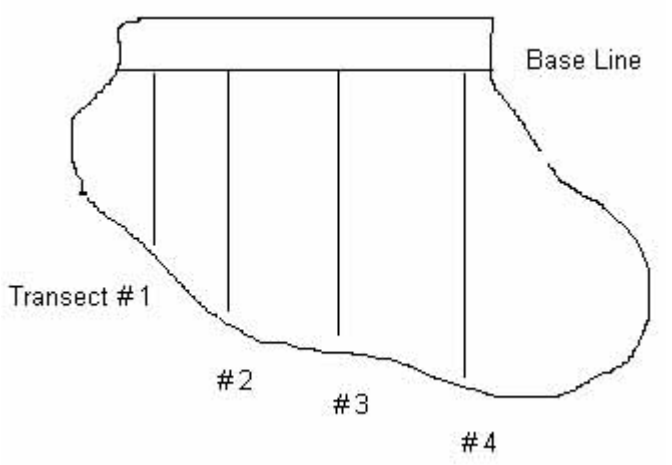


Figure 12. Method One, Transect Placement.

Method Two

In method two four random lines are drawn on the as-built plans. Use a compass and measuring tape to locate and stake the transect lines in the field.

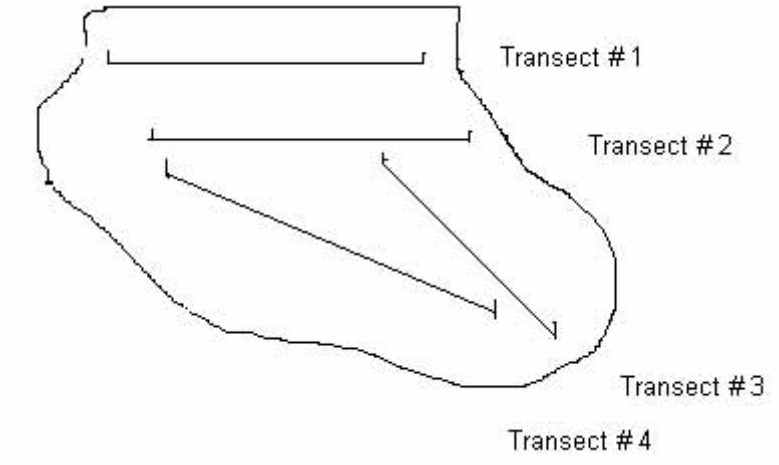


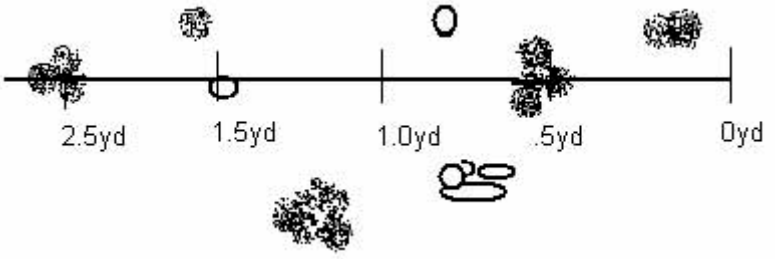
Figure 13. Method Two, Transect Placement.

4.3.2 Interrupted Line-Intercept Method

In this method volunteers will estimate the coverage of species that are intersected by the transect line. For each transect line, plants species or substrates occurring at every 0.5yd mark will be recorded. Information will be recorded on the Percentage of Cover-.Line-Intercept Method Form (Appendix B5). Supplies needed for this project are:

- Two team members
- 100 foot tape measure
- Pencils/Clipboards
- Percentage of Cover-Line-Intercept Method Form
- Camera

Stretch the tape measure from the starting stake to the ending stake of the first transect. Photograph the transect line looking from the starting point to the ending point. Starting at the 0 mark, identify and record the plant(s) or substrate that lies beneath the mark. Next, identify and record the plant or substrate that lies beneath the 0.5 yard mark, the 1.0yd mark, the 1.5yd mark, and so on for the length of the transect line. Native species will be identified and recorded by species name. All non-native/ruderal plants will be counted collectively as such and not identified to the species level. Substrate will be identified as rock, soil, leaf litter etc.



Point	Native Species	Non-Native	Substrate
0.0yd			Sand
0.5yd	Buckwheat		
1.0yd			Sand
1.5yd			Rock
2.0yd		Non-Native	

Figure 14. Example of Interrupted Line-Intercept Counts

The percent of coverage of each species along the transect is calculated as follows: Divide the total number of times each species was intersected by the transect by the total number of sample taken (50 for a 25 yard transect) and then multiply the quotient by 100 to get a percent. Repeat this process at the second, third, and fourth transect lines. Average the percent of cover across the four transect lines to determine absolute abundance. Record the percentage of cover for each native species, non-native/ruderal plants, and substrates on the Percentage of Cover-Line-intercept Method Form.

4.3.3 Quadrat Method

Sampling with quadrats, or plots of a standard size, is a widely accepted method of determining percentage of cover. It may be used in all major types of small vegetative communities. The size, shape, number and arrangement of quadrats will vary depending on the type of community and the type of information desired. The supplies needed for this project are:

- Three team members
- ½" Schedule 40 PVC pipe
- Four ½" Schedule 40 PVC elbows (90°)
- Scoring tool (knife)
- Thin twine or heavy fishing line
- 100 foot measuring tape
- Numbered chips from 1-5Right and 1-5Left
- Pencils/Clipboards
- Percentage of Cover-Quadrat Method Form
- Camera

A quadrat is a square frame with an inside measurement of exactly one yard square. A quadrat is typically made of PVC pipe (available at a local home improvement store). Cut the PVC pipe to size and fit the elbows into place to make a square. No glue is used so that the quadrat may be disassembled in the field and placed around vegetation if necessary. Once assembled, each side of the quadrat is scored at the 0.25yd mark, the 0.5yd mark and the 0.75yd mark. The twine or fishing line is stretched and tied from one side of the quadrat to the other to form a grid. The quadrat is now divided into 16 squares.

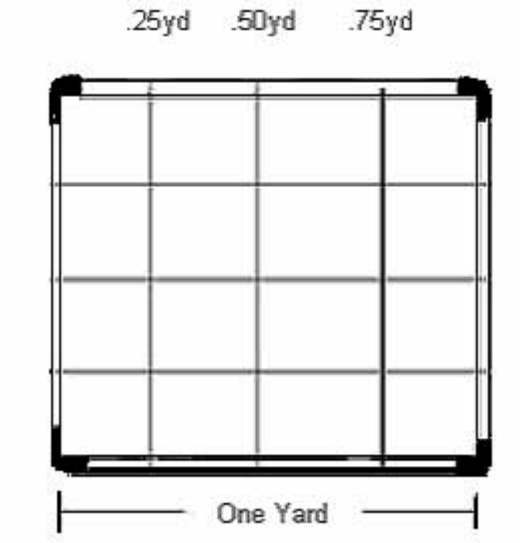


Figure 15. Example of Quadrat

Next, stretch the tape measure from the starting stake to the end stake of the first transect. Photograph the transect line looking from the starting point to the ending point. Quadrat placement along the transect will alternate from one side of the transect to the other.

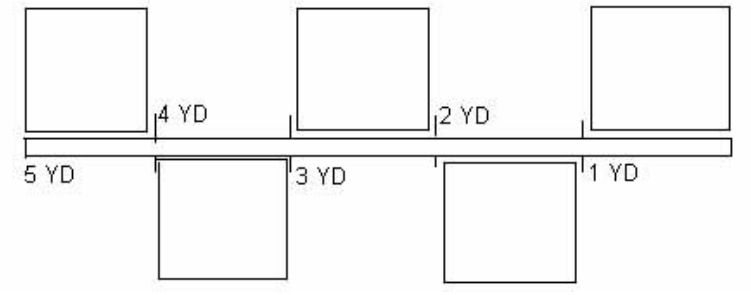


Figure 16. Quadrat Locations (Left to Right): 0R, 1L, 2R, 3L, & 4R.

Once in place, identify the individual plants within the quadrat. As in the line-intercept method, native plants will be identified and recorded by species, non-native/ruderal plants will be counted collectively, and substrates will be counted by type.

Next, count the number of small squares in which the species occurs (this value will range from 0-16). The species needs only to OCCUR in the square to be counted in that square. If, for example species A occurs in all 16 squares and species B also occurs in all 16 squares then both A and B would have abundance values of 16 for that quadrat. Do not include a plant whose rooted base lies outside the quadrat. Continue in this manner, selecting random starting numbers, to the end of the transect line.

Determine percentage of cover as follows: For each quadrat determine the total number of species occurrences (e.g., 16 for species A, 16 for species B, 10 for species C and 8 for Sand = 50 occurrences). Next, determine the relative percent cover of the species by dividing the species occurrence by the total occurrence and multiplying by 100 to get a percent (e.g., for species A: (16/50)*100= 32%). Average the total percentage for species A on transect line number one by adding the total percentages and divide by the number of quadrats counted. Repeat this process at the second, third, and fourth transect lines. Average the percent of cover across the four transect lines to determine absolute abundance. Record the percentage of cover for each native species, non-native/ruderal plants, and substrates on the Percentage of Cover-Quadrat Method Form(Appendix B6).

4.3.4 Comparison of Methods

Use the information recorded on the Percentage of Cover Forms to record the finalized totals on the Percentage of Cover-Comparison Form (Appendix B7). Compare the two methods and note the different results from each method. For the purpose of an annual report, the project coordinator will total the percentage of cover from each method and divide by two to arrive at an averaged percentage of cover for each species.

	Quad Location	Transect Section	Cover of Saltbush from Quads	Cover of Saltbush from transects
1	0-4 yd	0-5yd	10	15
2	5-9 yd	5.5-10yd	15	12
3	10-14 yd	10.5-15yd	65	50
4	15-19 yd	15.5-20yd	30	20
5	20-24 yd	20.5-25yd	20	15
6	25-29 yd	25.5-30yd	45	60
7	30-34 yd	30.5-35yd	90	75
8	35 -40 yd	35.5-40 yd	14	18

Figure 17 .Comparison of Methods.

4.4 Seedling Density

Seedling density will be monitored semi-annually (spring and fall) in restoration sites that utilized seed dispersal in addition to container plantings. This project will require the following supplies:

- Two team members
- As-built plans
- Planting plan
- Measuring tape
- Permanent reference stakes
- Mallet
- Quadrat
- Pencils/Clipboard
- Seedling Density Form
- Camera

Use the as-built plans as a guide to select a transect line location (as in Method Two above) within the seeded area. Use a compass and measuring tape to locate and permanently mark the line location in the field.

Assemble the quadrat without the grid lines. Have a copy of the Planting Plan with Seed List conveniently available. Use the method of random selection as described in section 4.3.3 to select the quadrat locations. All individuals within the quadrat will be counted and recorded. Follow the same guidelines for species identification of natives and non-native/ruderal species as explained above. Add the total number of individuals of each species in all quadrats per site and divide by the total area of all the quadrats to determine the density of each species. (e.g., Species A, 108/10m² = # per square yard)
Record all data on the Seedling Density Form (Appendix B8).

4.5 Distribution of Species

Distribution of species will be monitored in fall of Year 2 and Year 4. This information is valuable in determining the distribution of native species and why they did not spread into a particular part of the restoration site. The method used will be the same as that used to create the as-built plans (Section3.2 p.). Plot the data on vellum, label it appropriately, and have bond copies printed. Attach copies of the previous two years of monitoring reports and file.

5.0 BIOLOGICAL ASSESSMENT

No restoration site can be considered a success if the appropriate wildlife and birds do not utilize the site for food, shelter, perching, or breeding. A biological assessment will be conducted during each monthly site visit to identify which bird and wildlife species use the sites. Refer to Appendix A for the monitoring schedule.

5.1 Wildlife

The term "wildlife" will include mammals, amphibians, reptiles, butterflies, and moths. Wildlife will be confirmed by evidence of use and physical sightings. Evidence of use will include tracks, skat, burrows, nests, and signs of herbivorous activity. An animal behavior and tracking book should be available for volunteer use. *Stokes Nature Guides-A Guide to Animal Tracking and Behavior* by Donald & Lillian Stokes (Little, Brown & Company, 1986) is recommended for this project.

Wildlife assessments will during the monthly site visit. At each restoration site, prior to any other tasks, walk the site in a coordinated pattern and search the area for wildlife or signs of wildlife use. Volunteers in the field may need to speculate which species is present from several forms of evidence combined (e.g. Rabbit skat and herbivorous activity). Some signs of use may not lead to the identification of any particular wildlife species. For such signs, simply describe the finding. Note the observation of any butterflies, moths, or other pollinators during the site visit. Photo document the visit.

Record all findings on the Site Visit Form (Appendix B2). The Site Visit Form also provides an area for volunteers to recommend actions that may be needed to prevent further damage from wildlife use until plantings are established. Such suggestions might include the use of wire cages for protection of plantings.

5.2 Birds

The monitoring of bird activity will require observers proficient at identification. The UNB is a popular birding site among local residents. Many backyard birders will meet this requirement. Participants should have a bird identification handbook available. Recommended volumes include the *American Bird Conservancy's Field Guide-All the Birds of North America* by Jack L. Griggs (Harper Collins Publishers Inc. 1997) or Peterson Field Guides *Western Birds* by Roger Tory Peterson (Houghton Mifflin Company 1990). While in the field volunteers should make mental notes, and refer to the guides only after the count is finished. Bird monitoring will take place once every fourth month. The supplies needed for this project are:

- Four team members
- 100 Foot Tape Measure
- Stopwatch
- Pencils/Clipboards
- Bird Activity Form
- Bird Identification Guide
- Camera

A fixed distance circular point count requires a minimum of three team members (four is optimum). The count will take place at the photo point site in each restoration area. The volunteers will sit back to back at the photo point site, facing outward and each will count all birds sighted or heard within a 100 ft radius.

Team members will help each other define the area of the count. Each team member will alternately hold the 100 ft tape measure at the photo point site facing the direction he/she will face during the count. Another team member draws the tape out 100 ft. Using landmarks, familiarize yourself with the area between the photo point site and the 100 ft mark.

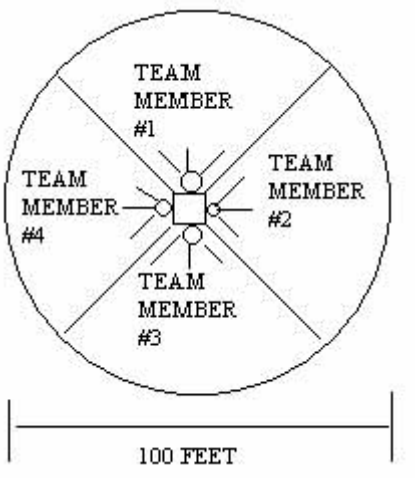


Figure 18. Bird Identification Arrangement.

Take photos from the photo points facing the 3-4 directions and identify the person counting this portion of the radius. Once seated, allow several minutes for birds to return to natural behavior. Remain still for duration of count. Set stopwatch for ten minutes. Record all sightings within the 100 ft radius for eight minutes; also, record bird sounds that are believed to originate from the count site. Make every effort not to double count sightings and soundings. Record all sightings or soundings on the Bird Activity Form (Appendix B9). Record if bird is at ground level or in flight, and whether the bird is identified in 0-5 minutes or 5-10 minutes. If species is unknown record the sighting as such. Record any nesting activity.

SPECIES NAME:(common name)

SIGHTING#	0-5 MIN	5-10 MIN	SEEN	HEARD	INFLIGHT	GROUND
one						
two						
three						
four						
five						
six						
seven						
eight						
nine						
ten						

Figure 19. Bird Activity Report

Calculate relative abundance for each species by dividing the number of individuals of a species within the radius by the total number of all birds of all species observed within the radius. Record all data on a Bird Activity Report.

6.0 PHOTO DOCUMENTATION

Photo documentation is an important tool in recognizing consistency between monitoring events. A photograph of the restoration site or monitoring site should be included with every site visit. Photos are to be taken prior to any monitoring activities.

6.1 Initial Photo Sites

Initial selection of photo points will be conducted by the project coordinator. When photo sites are first selected, consider the type and size of the restoration. If adjacent sites will be incorporated into the project, include these sites in the photo. Try to include landscape features that are unlikely to change during the project life (peaks, large trees, permanent structures, etc) in the photo. Consider seasonal changes in lighting, background, and contrasts. Select photo point using maps, aerial photos, permanent markers, landmarks, etc. Use GPS, latitude and longitude, and/or permanent markers to identify the point. Take a photo of each photo point. Create a set of ID points for each photo point (example: BV1 and BV1P). The P will distinguish between the actual photo sites (BV1) and the point where a photo of the photo site was taken (BV1P).

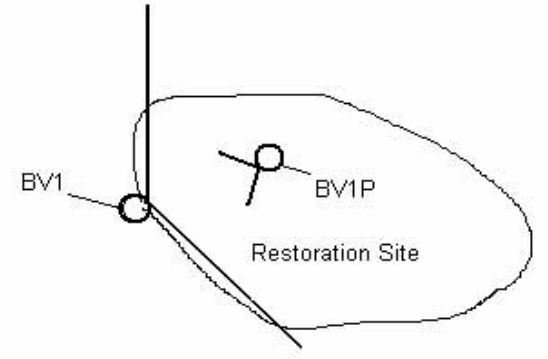


Figure 20. Example of Photo Points

6.2 General Instructions

From the inception of any photo documentation project until it is completed, always take each photo from; the same position (photo point), at the same bearing and vertical angle at that photo point. Refer to copies of previous photos when arriving at the photo point. Try to maintain a level (horizontal) camera view unless the terrain is sloped. (If photo cannot be horizontal due to the slope, then record the angle for the photo.)

Before each monitoring activity, volunteers will take a photo from the photo point site and take a photo of the photo point site. Use the established ID points to identify the photo point sites and record the information in the photo log (Appendix B10). For example BV1 will be the point that the photo in STEP 1 will be taken (this photo will be taken of the whole site). If the ID point has a P after it, then it will be the point that the second photo will be taken in STEP 2. The photo in STEP 2 will be taken of where you were standing when you took the photo in STEP 1.

PHOTO LOG

PHOTO #	DATE	STEP 1: ID point	STEP 2: ID point	PHOTOGRAPHER NAME	TEAM MEMBER NAME

Figure 21. Example of Photo Log

A photo log will be kept for each site. The log will include: the location of the photo; the date, the photographer's name; name of other group members/partner; and general notes (weather, cloud cover, time of photo, etc…).

6.2.1 Taking the Photo

Take all photos prior to monitoring/sampling. Locate photo point sites using GPS coordinates, reference stakes, or photos of the photo site. Complete a photo Sign Form (Appendix B11) for each photograph taken. Using a black marker record the location, subject description, date and time on the photo sign form. Have your partner hold the form and stand in a position that will insure that the form is visible in the photo but does not interfere with site photo. Take photos with camera provided.

7.0 MAINTENANCE DURING MONITORING

Coastal sage scrub communities with a 60% cover are able to reduce the occurrence of invasive species through biological means. Until this percentage of cover is reached, removal of invasive weed species will be necessary. Also, sites with irrigation systems will require periodic inspections and subsequent repairs will be likely.

7.1 Removal of Debris or Invasive Species

Maintenance will consist of manual weed control during a 2-3 year plant establishment period. At the Coastal Sage Scrub Restoration Experiment Site, the site preparation techniques proposed (wood chip mulch, seeding, mycorrhizal inoculation) should reduce weed growth and weeding requirements. However, weeds should be controlled within the irrigation basins/wood mulch area around each of the plantings. The weed control treatment should be identical across the irrigation treatments so it does not introduce an additional treatment factor and associated variability in plant growth response. The irrigation basins should be kept weed free by manual removal. Weed whacking of herbaceous vegetation between plantings is not recommended for this experiment. The planting basins should be repaired as needed, as well as the mulch replenished for the first three years to maintain a 3-inch depth of mulch (H.T. Harvey, 2002).

For other sites manual weeding should be done within the entire site if possible. If this is not within the constraint of the project then weeding should consist of hand clearing the area immediately around the initial plantings so reproduction by seeding can take place. All maintenance and weeding activities should be recorded on a Site Visit Form. Estimate the amount of biomass removed by pounds, count the number of pieces of debris removed from the site, and record any other activity completed while at the site.

7.2 Irrigation Systems Maintenance

Monitoring the irrigation systems requires a monthly site inspection. The inspection should be timed to occur within several days after the watering events. Note whether each plant has been successfully watered. Document any plantings that appear to be over-watered or under-watered. Make recommendations for changes to water schedule. Inspect the site for damage to the irrigation systems (vandalism, coyote chew marks, etc.). Any damage should be repaired as soon as possible, not only for water conservation reasons, but to prevent water-logging induced mortality. Record the results of the inspection and any work completed on a Site Visit Form.

8.0 ADAPTIVE MANAGEMENT

Adaptive management is a system of managing the ecosystem in which the methods of achieving the desired results are unknown or uncertain. The advantage to this management system is in its ability to provide the Restoration Education Project Coordinator with the latitude to make decisions taking the entire ecosystem into account. It is important to distinguish between adaptive management and perpetual maintenance. Adaptive management is a process applied to the project to improve the outcome. Perpetual maintenance is an operation carried out to remedy a specific situation.

Mistakes will probably be made during construction/planting. The project coordinator will need to determine if the mistakes need to be corrected, whether they are acceptable, or whether they enhance the site. Unexpected detrimental events may alter the site, requiring consideration of corrective measures. For example, invasion of an exotic species may

necessitate early and/or continued intervention. A decision will be required on how to control this invasion. Experiments or trials using different methods may be needed.

If the percent of survival of the initial plantings falls below 100 % in Years 1 and 2 or 80% in year 3, the project coordinator should replace those plantings. Species observed to perform well should be utilized to replace the dead individuals. But if seeding projects, irrigation projects, or other experiments fail to facilitate the restoration goals then the coordinator will need to decide if these projects should continue.

This monitoring plan, although adequate for current project parameters, may not be so in the future. Economic, social, and physical constraints may hamper monitoring efforts. Conversely, future funding may afford the opportunity to increase the quality and type of monitoring equipment. The current Restoration Education Project Coordinator must approve all changes to both the restoration and monitoring plans. Any such changes should be noted by attaching a draft and final amendment to this document. Any change to the forms used for documentation should also be recorded.

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APPENDIX G

Sample Donation Request Letter

CALIFORNIA
COASTAL
COMMISSION

RESTORATION EDUCATION PROGRAM

600 Shellmaker Drive
Newport Beach, California 92660
949-640-0286 [VOICE] 949-640-1742 [FAX]

TO: Marilyn Chambers, President
Tri C Enterprises, L.L.C.

Dear Ms. Chambers:

The California Coastal Commission, in cooperation with the City of Newport Beach, Orange County Harbors, Beaches & Parks, California Department of Fish and Game, and the Newport Bay Naturalists & Friends, coordinates a community-based restoration program for Upper Newport Bay (UNB). We organize monthly events where volunteers help weed, plant, monitor, and maintain restoration projects while learning about the importance of wetland habitat. A complementary high school curriculum helps teachers meet required Science Content Standards by connecting education with real life. We invite you to join our effort by donating mycorrhizae to support our project.

Renowned as the best birding site in North America, UNB holds critical feeding and breeding grounds for a magnificent array of wildlife. Many of these species are endangered; and healthy wetland areas—of which only 3% remain--represent their last and best chance for survival. Decades of intensive urban growth have seriously degraded the Bay's already sensitive habitats. Without immediate attention, problems like trespassing and non-native plant invasions threaten the vitality of UNB.

You can be part of the solution. We need approximately 30 pounds of granular mycorrhizal inoculum to set up a restoration site with 500 native plants. We will be learning effective watering strategies in coastal sage scrub areas by setting up experimental plots planted with natives. Using our non-profit tax identification number, 94-3213100, you could classify your contribution as tax-deductible. We would be happy to post your logo on site.

Sincerely,

Kristina Finstad

Restoration Education Project Coordinator

APPENDIX H

Sample Liability Release Form

RESTORATION PROJECT WAIVER OF LIABILITY AND EXPRESS ASSUMPTION OF RISK
(PLEASE READ CAREFULLY)

I agree as follows: 1. I am volunteering my services for Restoration and Education projects ("the Event") on a voluntary basis without anticipation of payment of any kind; 2. I will perform assigned tasks that are within my physical capability to the best of my ability, and I will not undertake tasks that are beyond my ability; 3. I am familiar with the safe operation and use of equipment and tools that I may utilize in connection with this volunteer activity, and I will not undertake to use any equipment or tools with which I am unfamiliar or do not know how to operate safely; 4. I acknowledge that I have received and read appropriate instruction regarding this Event, including appropriate safety and emergency procedures, and that I fully understand those instructions and that I agree, after proper inspection, to use only the supplies, tools and equipment provided by the Event organizers; 5. I will perform only those tasks assigned, observe all safety rules, and use care in the performance of my assignments; 6. I specifically acknowledge that I am engaging in this activity as a volunteer, at my own request and risk, and not as a State of California or Foundation employee, agent, official, officer or representative, and further acknowledge that I am not entitled to any compensation, benefit or insurance coverage from the State of California, the California Coastal Commission, the California Department of Fish and Game, the City of Newport Beach, the County of Orange Harbors Beaches and Parks, or any Event promoter or sponsor, nor will I make any such claim.

I understand and agree that neither the State of California, California Coastal Commission, the California Department of Fish and Game, the City of Newport Beach, the County of Orange Harbors Beaches and Parks, the Newport Bay Naturalists and Friends, the Irvine Company, the UC Master Gardeners, nor any of their respective employees, officers, agents or assigns, (hereinafter collectively referred to as "Released Parties"), may be held liable or responsible in any way for any injury, death or other damages to me or my family, heirs, or assigns that may occur as a result of my participation in this activity, or as a result of product liability or the negligence of any party, including Released Parties, whether passive or active.

I understand that working to restore coastal areas involves certain inherent risks, including but not limited to, the risks of possible injury or irritation from contact with plants, especially those with thorns, , or from over-exertion or environmental conditions. Despite these risks, I still choose to proceed in such activity.

I know of no physical limitation which should keep me from undertaking the activities associated with this Event. In Consideration for being allowed to participate in this activity, I hereby personally assume all risks in connection with the Event for any harm, injury or damage that may befall me as a participant, including all risks connected therewith, whether foreseen or unforeseen. I further save and hold harmless said activity and Released Parties from any claim or lawsuit for personal injury, property damage, or wrongful death, by me, my family, estate, heirs, or assigns, arising out of participation in this activity, including both claims arising during the activity and after I complete the activity.

If I should become injured while participating in the Event, I authorize any physician or surgeon licensed in the State of California to perform emergency or surgical treatment as in his or her sole judgment may be necessary. I further declare that I am over the age of eighteen and legally competent to sign this liability release, or that I have acquired the written consent of my parent or guardian. I understand that the terms herein are contractual and not a mere recital, that this instrument is a legally binding, and that I have signed this document of my own free act.

BY THIS INSTRUMENT I DO HEREBY EXEMPT AND RELEASE ALL "RELEASED PARTIES," AS DEFINED ABOVE, FROM ALL LIABILITY OR RESPONSIBILITY WHATSOEVER FOR PERSONAL INJURY, PROPERTY DAMAGE OR WRONGFUL DEATH, HOWEVER CAUSED, INCLUDING NEGLIGENCE OF THE RELEASED PARTIES, WHETHER PASSIVE OR ACTIVE.

I HAVE FULLY INFORMED MYSELF OF THE CONTENTS OF THIS WAIVER OF LIABILITY AND ASSUMPTION OF RISK BY READING IT BEFORE I SIGNED IT ON BEHALF OF MYSELF AND MY HEIRS.

_____ _____ _____
Spelling of Participant's Name Date Phone

_____
Signature of Participant

_____
Address

Optional information:
How did you hear about ROOTS? _____

If you would like to receive ROOTS news, please provide your email address: _____
Email Address

IF PARTICIPANT IS UNDER 18, THE PARENT (OR GUARDIAN, IF ANY) MUST SIGN.
I am the parent or legal guardian of the above participant and he/she has my permission to participate in ROOTS. I have read and agree to the provisions stated above. I know of no health limitations which may restrict this volunteer's participation in this activity.

_____ _____ _____ _____
Signature of Parent or Legal Guardian Date Phone

_____
Address