DRAFT

MORAN LAKE

MONARCH BUTTERFLY HABITAT MANAGEMENT PLAN

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Prepared for:
The Santa Cruz County Parks, Open Space & Cultural Services

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DRAFT

TABLE OF CONTENTS

DRAFT

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EXECUTIVE SUMMARY

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This report integrates previous habitat reports and studies of the monarch butterfly wintering habitats at Moran Lake in Santa Cruz County, California. The primary objective of this report is to approach the restoration and preservation of the wintering habitats under one integrated management plan for the County of Santa Cruz Parks, Open Space & Cultural Services (County Parks Department). The previous reports incorporated here include:

- Management Plan for the Monarch Habitat at Moran County Lake Park (November 2004, Joni L. Janecki & Associates)
- Management Plan for the Monarch Habitat at the D. A. Porath Sanitation Facility of the Santa Cruz County Sanitation District (February 2006, Joni L. Janecki & Associates, Inc.)

And portions of the:

- Moran Lake Water Quality Study & Conceptual Restoration Plan prepared for the Santa Cruz County Redevelopment Agency (February 2005, John Gilchrist & Associates and Fall Creek Engineering).

A Memorandum of Understanding (MOU) between the Santa Cruz County Parks Department and the Santa Cruz County Sanitation District establishes that the County Parks Department will manage the preservation and restoration of the overwintering habitats surrounding Moran Lake, including Moran Lake County Park and the Sanitation District's D. A. Porath Sanitation Facility. Accordingly, this report includes an overview of the existing conditions impacting the butterfly habitat, recommendations for short and long-term actions necessary to preserve, restore and enhance the habitat, recommended actions for improving public safety, and recommendations for on-going periodic evaluations to assess tree health and potential hazards. Recommended actions to address other issues such as restoration of the lagoon and creek corridor at Moran Lake are incorporated as they address the overall health of the monarch butterfly wintering habitat. Finally, public access improvements are integrated as an element of the overall vision for County Parks Department's implementation of this management plan.

The following page summarizes the General Recommendations and Specific Recommendations that, when implemented, will afford the County and community an opportunity to stabilize, rehabilitate and preserve this unique monarch butterfly habitat.

EXECUTIVE SUMMARY

SUMMARY OF GENERAL RECOMMENDATIONS

1. Approach the preservation and management of the Moran Lake wintering habitat as a whole, including the private properties surrounding publicly owned properties. In addition to the direct habitat care of the trees and nectar understory, the dynamic relationship of the lagoon, riparian corridor, ocean and developed lands should be integrated into habitat management efforts.

2. Establish guidelines for monitoring the status of the monarch butterflies.

3. Stabilize and protect the existing trees, groves and windscreens by:

    - Elective pruning and trimming of the trees to maintain public safety and the integrity and biological functionality of the groves
    - Selective tree removal
    - Management of the understory vegetation
    - Improve drainage and eliminate ponding of water around tree roots
    - Planting new habitat-specific trees

4. Manage non-native plants that provide nectar, remove invasive non-native plants, and restore with wetland and upland species in select locations.

5. Incorporate interpretive signage to educate the public about the dynamic ecosystems, habitats, and species of the Moran Lake area.

6. Manage storm water runoff to protect the water quality of Moran Lake riparian corridor and Monterey Bay National Marine Sanctuary.

7. Develop public education and community volunteer effort to foster long term stewardship and restoration of the Moran Lake area.

SUMMARY OF SPECIFIC RECOMMENDATIONS

A diagrammatic Habitat Management & Park Improvement map of the Moran Lake Wintering Habitat illustrates where specific recommendations are to be implemented (Figure 38).

The recommendations numbered on the plan correspond to actions to be taken at the specific areas including park improvements, windrows, nectar source vegetation, and roosting areas. Diagrammatic photos with planting recommendations are provided as well as storm water management improvements and bank stabilization at the lake margins. Finally, the plan includes park upgrades such as:

- Improved access
- Trail stabilization and boardwalk installation
- Interpretive signage
- New ADA-compliant restroom
- ADA-compliant picnic areas and overlooks
- Reconfigured parking areas
- New plantings to enhance the monarch butterfly wintering habitat and improve drainage areas

Integrating improvements to the park and overall habitat enhancement into this management plan strengthens the awareness of the connection between human activities and monarch butterfly wintering habitat of the Moran Lake area.

1.1 SCOPE OF THIS STUDY

PURPOSE:

This plan is intended to serve as a tool to guide park managers in balancing the often-conflicting goals of public safety and management of park lands with the habitat needs of the wintering monarch butterflies (*Danaus plexippus*). In addition, this plan provides background information and guidance for the restoration and enhancement of the traditional lakeside roost areas within the park and Sanitation Department's lands.

This plan comes at a critical time for maintaining a viable wintering habitat for the monarch butterfly at Moran Lake. Over the past twenty years much of the traditional monarch butterfly wintering habitat at Moran Lake has been significantly impacted due to several factors including: tree loss due to natural causes, permitted and non-permitted tree removal, improper tree maintenance and tree loss due to poor drainage. These factors, combined with the absence of a cooperative management plan that coordinates the activities of county agencies and local property owners, place the monarch butterfly wintering habitat at Moran Lake in jeopardy.

The monarch butterfly is not bound by property lines or jurisdictional boundaries and relies on the entire habitat area for its winter survival. Individual trees, windscreens and understory vegetation play critical roles in maintaining the suitability of an area to support monarch butterfly wintering populations. Ultimately, preservation and restoration of Moran Lake and its associated riparian corridor are dependent upon the development and implementation of a comprehensive master plan for the county park, creek corridor and the Santa Cruz Sanitation Facility habitat as a whole.

State and local regulations are in place to provide protection of the monarch butterfly and its wintering habitats. Frequently, property owners are unclear regarding the regulatory framework that their property is bound by. At the state level, the California Environmental Quality Act (CEQA), the Public Resources Code, and the Fish & Game Code all consider wintering habitats for the monarch butterfly as "sensitive habitat." Locally, the Santa Cruz County General Plan and the Local Coastal Plan (LCP) policies apply as well. Public awareness and enforcement of these regulations is essential to maintaining the wintering habitat.

PROCESS:

The MOU between the Santa Cruz County Parks Department and the Santa Cruz County Sanitation District was adopted by the Santa Cruz County Board of Supervisors in March 2006. The Santa Cruz County Parks Department retained Joni L. Janecki & Associates, Inc. to combine the management reports into one document with input from agency stake holders and incorporate the needed public access improvements within Moran Lake County Park.

A workshop was held with multiple stakeholder agencies including: Santa Cruz County Parks Department, the Santa Cruz County Sanitation District, the California Coastal Commission, Santa Cruz County Redevelopment Agency, Santa Cruz County Planning Department, Santa Cruz County Public Works, and California Department of Fish and Game in order to gain consensus on the approach and scope of the project. Decisions reached in the workshop helped to guide the recommendations described in this report. A draft outline was prepared and submitted to the Santa Cruz County Parks Department for review.

A final draft report will be prepared and presented at a County Board of Supervisors public hearing. Upon Board approval of the final draft, the report will be submitted with the permit packages for the park improvement projects for review to ensure compliance with CEQA (California Environmental Quality Act), County Development, and the Coastal Development Permit processes. Implementation of habitat and park improvements can then follow.

1.2 SETTING & SITE OVERVIEW

OVERVIEW OF MORAN LAKE WINTERING HABITAT AREA

The Moran Lake watershed encompasses approximately 620 acres. The watershed extends southward from Soquel Drive in the north to Monterey Bay National Marine Sanctuary in the south and is bounded by Twenty-sixth and Thirtieth Avenues in the west and by Forty-first Avenue in the east. Over the past four decades the watershed has undergone extensive development and urbanization which has led to a significant increase in impervious surface area which has created serious runoff, erosion and pollution problems for Moran Lake. Erosion is present in several locations along the lakeshore and creek, and in some cases has contributed to tree loss.

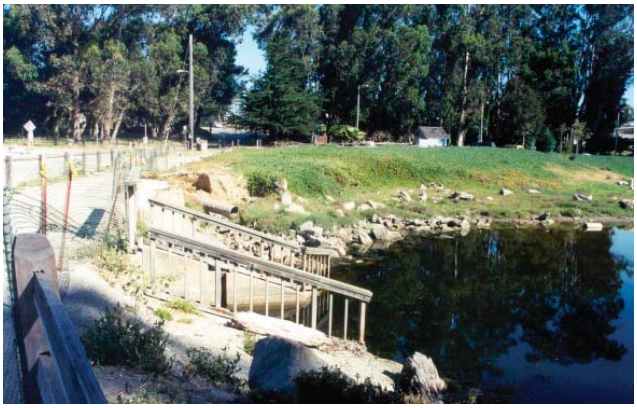
The name Moran Lake was probably taken from a former landowner, Patrick Moran who owned the property in the late 1800's. The lake was originally a coastal lagoon and subjected to tidal saltwater flushing. Today the water body is connected to the ocean by a large concrete culvert (Figure 1).

The 1980 Environmental Baseline Study for the Moran Lake Enhancement Plan, prepared by Stern and Courter, reported that in the 1960's the lagoon was reduced in size by three (3) acres when fill from a harbor dredging and development project was deposited at the south end of the lake. At this time a new drainage culvert was installed about 5 feet above the mean high tide level which cut off the direct connection between the lagoon and the ocean. The harbor fill was comprised of a mix of soil types including clay, silt, sand, and crushed granite.

The land surrounding and including Moran Lake became the property of the Santa Cruz County Department of Parks and Recreation in March 1975 to create a nature park. This land purchase was made possible by funding from the Land and Water Conservation Fund, with matching funds from the County of Santa Cruz, and assistance from the State Coastal Conservancy (Stern and Courter, 1980). The park is approximately 9.2 acres and includes portions of a creek (extending north to Thirtieth Avenue), which provides year-round water flow.

In 1988, a paved parking lot and restrooms were added to improve public access to Moran Lake County Beach (Figure 2). Today, the park includes parking facilities, restrooms, picnic tables, trails, open space, and beach access. The park primarily serves as open space for local residents.

The Moran Lake wintering habitat area also consists of land owned by the Santa Cruz Sanitation Department known as the D. A. Porath Sanitation Facility. This facility is the site for all maintenance on the County sewer system and serves as the primary pumping station between the City of Santa Cruz treatment plant and the sewer system in the eastern portion of the county. The facility is bound on all sides by a blue-gum eucalyptus (*Eucalyptus globulus*) forest that serves as a monarch butterfly wintering site.



Outlet at East Cliff Drive (Figure 1)

Park Restroom and Parking Lot (Figure 2)

1.2 SETTING & SITE OVERVIEW

PUBLIC LANDS, NEIGHBORHOOD LANDS & WINTERING HABITAT AREA

The map below (Figure 3) shows property ownerships within the monarch butterfly wintering habitat area. Moran Lake County Park, together with the County Sanitation Facility at the end of Lode Street and a small parcel owned by the City of Santa Cruz, near 30th Avenue, form a series of publicly held parcels which encompass the majority of the Moran Lake wintering habitat. The remaining lands, including a portion of the upper Moran Lake riparian (creek) area and a portion of the monarch butterfly wintering habitat is private (residential) property.

The fact that a portion of the butterfly habitat is on private land adds complexity to the implementation of this management plan and implies required coordination and cooperation between the public agencies and private landowners. To avoid further impact on the monarch butterfly habitat within the park boundary all portions of the Moran Lake wintering habitat must be cohesively managed.

Project Area and Context (Figure 3)

1.3 MANAGEMENT ISSUES

The Moran Lake area presents a confluence of planning, environmental and land use issues. Land use pressures have impacted the hydrological function of Moran Lake as a coastal lagoon and likewise impacted the quality of the unique habitat required by the monarch butterfly. Public infrastructure, recreational open space, beach access, neighborhood connections, and private property concerns converge at the Moran Lake area.

Monarch Butterfly Roost Cluster (Figure 4)

Entering the Forest (Figure 5)

View of Moran Lake and Main Picnic Area (Figure 6)

1.3 MANAGEMENT ISSUES

HISTORICAL PATTERNS OF THE MONARCH BUTTERFLY WINTERING HABITAT AT MORAN LAKE

Monarch butterflies are present in the Moran Lake wintering habitat from October through February in most years, and small numbers have been observed as early as mid-August and as late as April in some years. Based on its continual occupation by monarch butterflies throughout the wintering period, the habitat at Moran Lake is classified as a full-term overwintering habitat.

In the past (1980s), monarchs typically began to congregate along the northwestern shore of Moran Lake during early October, and formed clusters in the North and South Lakeside roost areas. As the population increased during October, clusters also formed in the North and South Creekside roost areas and the lakeside butterflies gradually shifted north into the more sheltered creekside roost areas (Figure 9). Then around mid-November the population shifted its clusters into the Primary Roosting area where they remained until warming temperatures initiated the spring migration sometime in February.

The North Lakeside roost area usually supported clusters of roosting monarchs throughout the month of October, whereas the South Lakeside roost area typically supported clusters only intermittently during the fall. Thus the North Lakeside roost area historically functioned as an autumnal roost area and the South Lakeside roost area functioned as refuge/ bivouac habitat. Tree and limb loss in these habitats has since reduced wind protection and eliminated many of the lower roost limbs that once supported clusters. Currently both roost areas function as refuge/ bivouac habitats.

HABITAT SIGNIFICANCE AT MORAN LAKE

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The monarch butterfly wintering habitat at Moran Lake currently supports the second largest population of wintering monarchs in Santa Cruz County (20% of the county-wide wintering population), and a considerable portion of the state-wide wintering population (5%). Although two to three hundred wintering sites have been identified along the California coastline (from Mendocino County in the north to San Diego County in the south), relatively few of these sites currently support large populations throughout the wintering period. In addition, many of the sites have been destroyed since they were documented. Wintering populations of similar magnitude to Moran Lake occur at only about 25 other sites in California with approximately 5 located in the Monterey Bay region.

Central Coast Overwintering Habitats

1.3 MANAGEMENT ISSUES

CURRENT MONARCH BUTTERFLY WINTERING HABITAT UTILIZATION AT MORAN LAKE

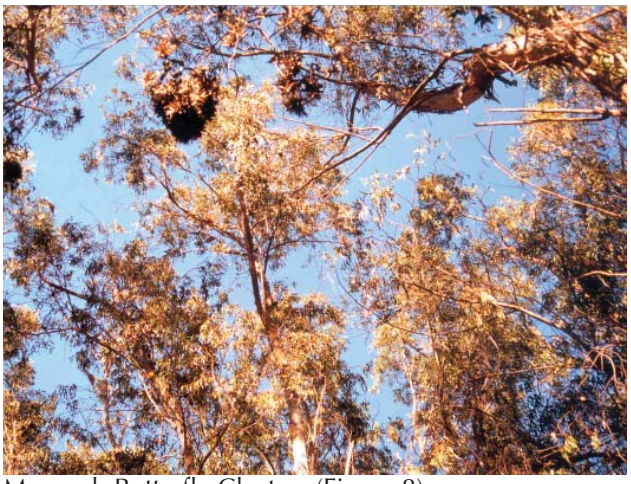
Tree and limb losses in the North Creekside roost area have degraded this habitat over the past ten years resulting in less frequent occupation of the North Creekside roost area and a gradual shift of occupation to the South Creekside roost area. In March/April of 1999, residents on the property adjacent to the South Creekside roost area removed all the eucalyptus trees on their property along the east side of the creek and in that process eliminated all of the eastern windbreak/shade trees that sheltered the South Creekside roost area. During the winter preceding the tree removal (1998-99) the entire wintering population at Moran Lake (approximately 18,000 monarchs) occupied the South Creekside roost area from early October through most of November. During the winter of 1999-2000, no clusters were observed in the South Creekside roost area. Both North and South Creekside roost areas now function only intermittently as refuge/bivouac habitat.

The Primary Roosting area, despite several significant tree removal events, has consistently supported mid-winter monarch populations for at least the past twenty years. With the loss of suitable autumnal habitat in the Lakeside and Creekside roost areas, the Primary Roosting area has now begun to function additionally as autumnal roost habitat. The Primary Roosting area is the only consistently occupied roost area remaining in the Moran Lake monarch wintering habitat.

The grove of eucalyptus at the southeastern end of Moran Lake—the Southeastern Grove, which includes the Moran Way Windrow—in addition to providing critical wind protection for the lake area, functions intermittently as refuge/bivouac habitat and occasionally supports small clusters during periods when monarchs are migrating and winds are relatively calm.

Refer to Figure 9 for the following eight roost areas defined: (A) the Southeast Grove (which includes the Moran Way windrow); (B) the South Lakeside Roost Area; (C) the North Lakeside Roost Area; (D) the South Creekside Roost Area; (E) the North Creekside Roost Area; (F) the Primary Roosting Area (at the north end of the D. A. Porath Sanitation Facility); (G) the Wind Buffer and Field; and (H) the Critical Windbreak.

Existing Conditions North East of North Lakeside Roost Area (Figure 7)



Monarch Butterfly Clusters (Figure 8)

1.3 MANAGEMENT ISSUES

A Southeast Grove & Moran Way Windrow
B South Lakeside
C North Lakeside
D South Creekside
E North Creekside
F Primary Roosting Area
G Wind Buffer & Field
H Critical Windbreak

Monarch Butterfly Roost Areas at Moran Lake Habitat Area (Figure 9)

1.3 MANAGEMENT ISSUES

EUCALYPTUS GROVES & EXISTING VEGETATION

The dominant vegetation of the Moran Lake wintering habitat area is blue-gum eucalyptus (*Eucalyptus globulus*). Most of the blue-gum eucalyptus trees that line Moran Lake today were probably planted as windbreak trees around the turn of the previous century (late 1800's or early 1900's) (Figure 10). The trees were well established by 1929 (based on aerial photos) and were likely planted by the owner of two adjacent wood lots to the north of the lake. The remains of one of these woodlots now surround the Sanitation District's D. A. Porath Sanitation Facility (Figure 11). Such woodlots provided important sources of firewood during the era before petroleum technologies became widespread (around 1920), and thus reduced the need for people to cut down what little remained of accessible native trees.

As petroleum technologies replaced the need for firewood, most of the eucalyptus woodlot enterprises in California became unprofitable and were abandoned. Today the abandoned woodlots and windbreaks provide habitat for wintering monarch butterflies, as well as many native birds and other organisms, that require forest solitude within the increasingly urbanized coastal communities. The tall, densely planted trees that line Moran Lake and the D. A. Porath Sanitation Facility provide essential wind protection which—coupled with proximity to the ocean and other factors—meets the basic habitat requirements for wintering monarchs.

Moran Lake County Park from East Cliff Drive (Figure 10)

WHERE DID THE MONARCH BUTTERFLY ROOST BEFORE THE EUCALYPTUS?

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Prior to urban growth, the coastal canyons and foothills provided woodland canopy and protection for the monarch butterfly. As areas have developed and the Eucalyptus forests have established, the monarch butterfly migrated from the developed areas to the Eucalyptus forest.

D. A. Porath Sanitation Facility Entrance from Lode Street (Figure 11)

1.3 MANAGEMENT ISSUES

Although the eucalyptus trees in the Moran Lake wintering habitat are in reasonably good health, crowding has created structural problems within the groves. Crowding increases competition for sunlight, water and mineral nutrients among the trees, and also leads to a condition of interdependence, wherein each tree provides (among other things) wind protection for its neighbors. Thus, although thinning a grove may reduce competition among the trees, it also increases vulnerability to wind damage. In addition, many of the trees surrounding the D. A. Porath Sanitation Facility, and a few among the lakeside windbreaks, have coppice sprouted (stump-sprouted) from previous cuts (Figure 12). Trees resulting from coppice sprouting tend to have weaker root systems and exhibit a greater tendency for structural failure from wind.

Competition for light among the densely planted eucalyptus has, in some cases, also resulted in abnormal lengthening of branches (Figure 13). Such branches tend to develop excessive end-weight problems that increase the likelihood of branch failure. Branch failure and tree failure are normal processes in natural forest settings, however, in the setting of an urban park, such failures are also important concerns for human safety.

Trees blown down by wind (wind-throw) along the margin of the lake during the winter of 1997-98, and subsequent tree removals, significantly reduced wind protection for the autumnal roost habitat at the north end of the lake. A mixture of redwood (*Sequoia sempervirens*) and flooded-gum eucalyptus (*Eucalyptus rudis*) was planted as partial mitigation for tree losses in the area adjacent to the autumnal habitat and are now beginning to show good growth rates. However, since this planting, the flooded-gums have become infested by aphid-like insects known as red-gum lerp psyllids (*Glycaspis brimblecombei*) which are reducing the vigor of the trees. Biocontrol agents (tiny host-specific wasps) are presently being reared and released in several locations in the state and may eventually control the state-wide lerp psyllid problem. Blue-gum eucalyptus are not susceptible to the lerp psyllids and although the flooded gum trees had shown positive growth, this particular species is not recommended for re-use.

Coppice Sprouted Tree (Figure 12)

Overhanging Limb with Excessive Endweight (Figure 13)

1.3 MANAGEMENT ISSUES

Mixed among the eucalyptus at Moran Lake are native and non-native trees, shrubs, grasses and herbs including:

- Redwood (*Sequoia sempervirens*)
- Monterey cypress (*Cupressus macrocarpa*)
- Coast live oak (*Quercus agrifolia*)
- Poison oak (*Toxicodendron diversilobum*)
- French broom (*Genista monspressulana*)
- English ivy (*Hedera helix*)
- Cape ivy (*Dalairia odorata*)

English ivy flowers attract monarchs in the fall and provide essential nectar which the monarchs utilize to build-up fat (energy) reserves for the winter. Cape ivy blooms in midwinter (December-February) and is an important source of nectar for monarchs who run low on fat reserves before the spring migration phase. Both English ivy and cape ivy are considered nuisance species because of their propensity to spread through the understory in the semi-shaded confines of tree groves (Figure 14); however, because of their important roles as nectar species for wintering monarchs, their presence in this instance should be tolerated and managed unless it is causing an eminent threat to the life of a tree.

Cape Ivy Growing in the Canopy (Figure 14)

Monterey Cypress (Figure 15)

Himalayan Blackberry (Figure 16)

English Ivy (Figure 17)

French Broom (Figure 18)

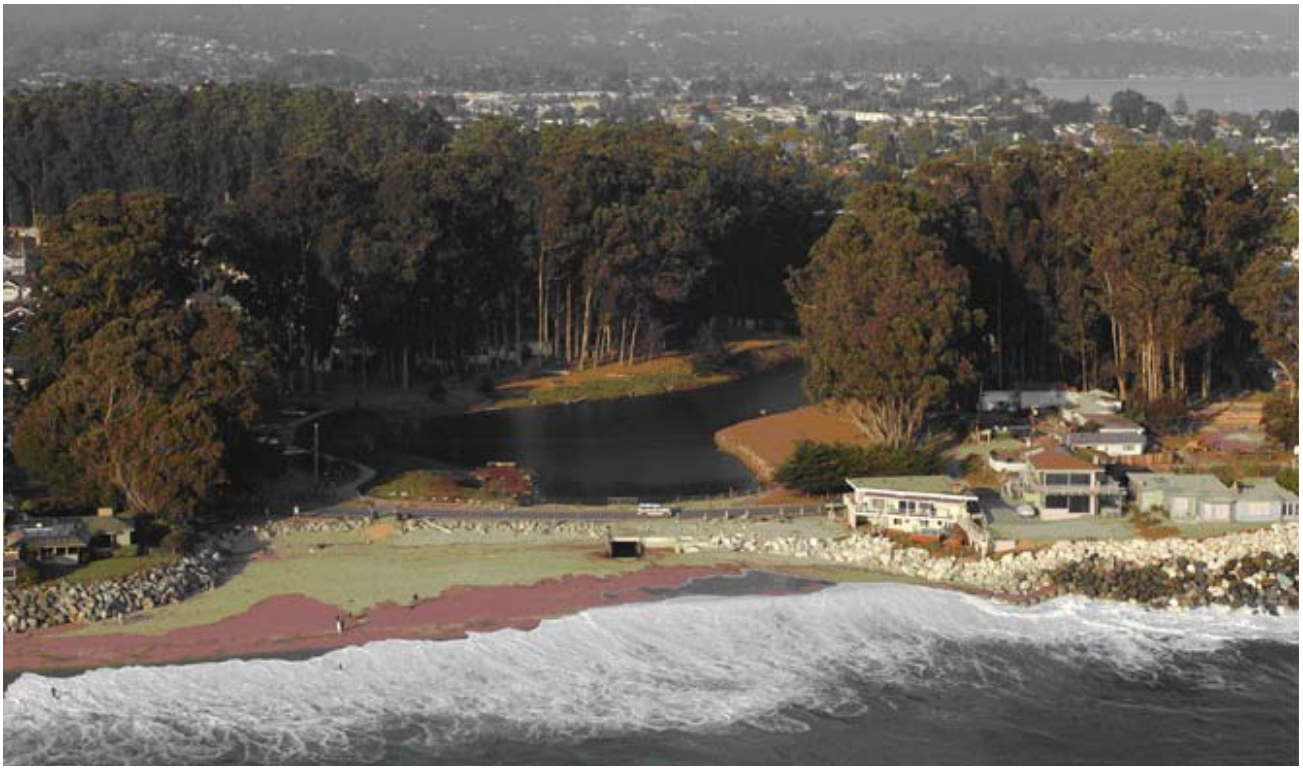
1.3 MANAGEMENT ISSUES

HYDROLOGY

Moran Lake is a coastal lagoon. In general terms a coastal lagoon is a body of brackish, marine or hypersaline water impounded by a sandy barrier and having an inlet connecting with the open ocean. Precipitation in the coastal watershed occurs almost entirely as rainfall. Precipitation rates on the coast range from 24-28 inches per year with approximately 80 percent of precipitation occurring between November and March (Hickey, 1968).

DRAINAGE PATTERNS

Between 1961 and 1963, dredge material removed from Wood's Lagoon for the development of the Santa Cruz Yacht Harbor was deposited in Moran Lake, effectively reducing the surface water area of the lake by three acres. Another significant change in the Moran Lake watershed was the transformation from open grassland and forested coastal terrace, to a rural farming community, and then into high density residential and commercial-industrial land uses. The result of these land use changes greatly increased the impervious surface area in the watershed, altering the hydrologic response, timing, volume, and quality of stormwater entering Moran Lake (John Gilchrist & Associates and Fall Creek Engineering, 2005). The hydrologic response of surface waters in the Moran Lake watershed has been modified as a result of development and land use changes in the area. Historical fill practices have significantly reduced the volume and depth of the lagoon, which has affected the lagoon's ability to assimilate or dilute pollutants entering the lagoon during winter runoff events. Increased development has also increased the impervious surface area which has decreased infiltration capacity and increased the volume of water entering Moran Lake, and its principal tributary Moran Creek. The decreased infiltration capacity has also increased the rate at which water moves through the watershed and enters these water bodies immediately after rainfall events. Impervious surfacing also decreases groundwater storage in the watershed, decreasing natural discharge to water bodies during dry months. Moran Creek and its smaller tributary channels have also been channelized, buried, or the riparian corridor reduced, causing impacts to the watershed hydrology (John Gilchrist & Associates and Fall Creek Engineering, 2005).



Moran Lake Outlet (September 2002) Photo: California Coastal Commission (Figure 19)

1.3 MANAGEMENT ISSUES

During the period when the spoils from the Santa Cruz Yacht Harbor were deposited in the Moran Lake area, a 7-foot diameter culvert was installed at the lake outlet, approximately five feet above the mean high tide level, blocking the lagoon inlet and transforming the coastal lagoon into an inland lake. In 1981 the 7-foot diameter culvert was replaced with the existing box culvert beneath East Cliff Drive. The bottom of the box culvert was set at one foot below mean sea level (Figure 20). In a natural lagoon system the inlet is in a state of dynamic equilibrium, meaning that the inlet configuration (location, cross-sectional area and depth) responds primarily to seasonal variations in the water flow, water levels, littoral drift, and wave action. The culvert and roadbed have "stabilized" the lagoon inlet preventing the natural migration of the inlet channel in response to wave and storm events. Maintaining a stable inlet is also important to protect public infrastructure and private properties surrounding the lagoon from flooding (Figure 21). This engineered structure reduces circulation and tidal flushing of the lagoon resulting in degraded water quality and aquatic habitat conditions (John Gilchrist & Associates and Fall Creek Engineering, 2005) (Figure 22).

Eroding Bank on Eastern Shore of Moran Lake (Figure 21)

Box Culvert at Moran Lake Beach (Photo: FCE) (Figure 20)

Moran Creek (Figure 22)

1.3 MANAGEMENT ISSUES

In 1953 the Santa Cruz County Sanitation Department constructed the D. A. Porath Sanitation Facility at the end of Lode Street (near the north end of Moran Lake). As part of this development, a sewer line was installed along the western margin of the lake. Installation of this sewer line modified drainage patterns along the western lake margin by creating berms and swales that restrict runoff flowing toward the lake. This modification has resulted in saturated soils and water ponding around the root systems of some of the blue-gum eucalyptus trees along the western margin of the lake (Figure 23).

Although blue-gum eucalyptus are somewhat tolerant of saturated soil conditions, the excessive water build-up has in some cases led to a weakening of the soil structure and subsequent loss of trees from wind-throw due to soil and root failure (Figure 24). The problem is compounded by the interdependency of wind protection among the densely planted trees, since with each tree lost, the remaining trees become less protected from wind. Altering this pattern of tree loss is of paramount importance both for public safety reasons and for preservation of the monarch butterfly wintering habitat.

Existing Drainage Channel at D. A. Porath Sanitation Facility (Figure 23)

The primary land use within the watershed is residential. Development in the past forty (40) years has resulted in a dramatic increase in impervious surface area, thereby increasing the amount of urban runoff and non-point source pollution (Figure 25). Visible signs of erosion are present throughout the park. Much of the stream bank above the lake is steep sided with erosion rills and signs of sediment loss.

Saturated Area Causing Tree Failure (Figure 24)

Runoff from Warren Street Towards Park (Figure 25)

1.3 MANAGEMENT ISSUES

PUBLIC PARK USE

Currently, the Moran Lake County Park facilities include parking, a restroom, beach access, nature trail, and wildlife viewing (Figures 26-28). To ensure success of a habitat management plan in a highly urbanized park, human interface and competing land uses need to be integrated as part of the plan.

Residents of the surrounding neighborhoods are the biggest user groups of the Moran Lake County Park. The park provides neighborhood connections to and from the beach while staying off the busy East Cliff corridor. The parking and picnic facilities are used by residents and visitors from Santa Cruz County and beyond. School groups utilize the park facilities as a locale to teach about the monarch butterfly migration and other issues surrounding the coastal lagoon.

As a highly visible and utilized county park, the older facilities are in need of improvements. Improvements to the park will ensure ADA accessibility, integrate the parking area into the larger landscape systems, provide new accessible restrooms, and interpretive elements along the nature trail. Moran Lake County Park provides exceptional opportunities for public education and outreach.

View Towards East Cliff (Figure 26)

Existing Picnic Area at Moran Lake (Figure 27)

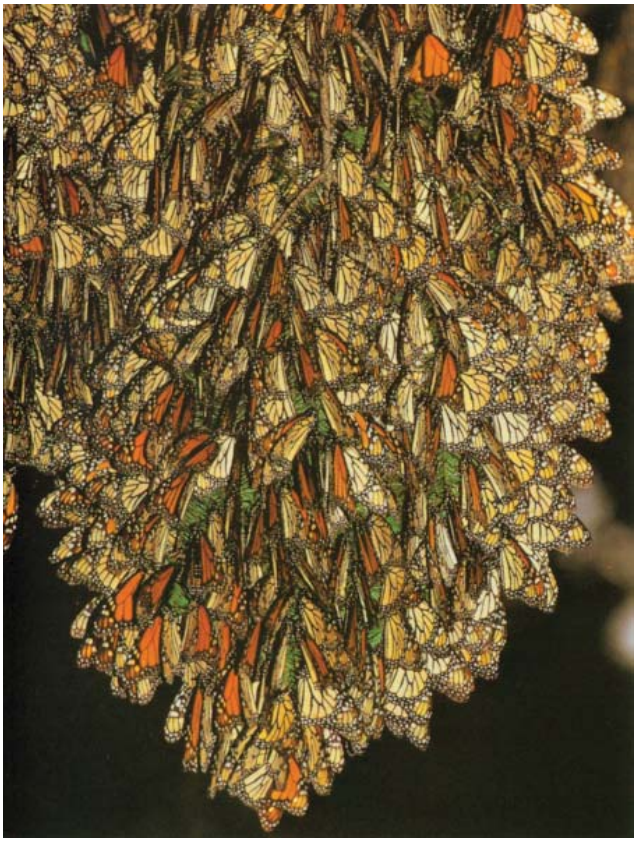
Existing Facilities at Moran Lake Park (Figure 28)

2.1 GENERAL RECOMMENDATIONS

PRESERVATION OF THE MORAN LAKE MONARCH BUTTERFLY WINTERING HABITAT

This management plan addresses issues related to the restoration, preservation and enhancement of that portion of the monarch butterfly wintering habitat at Moran Lake that lies within the bounds of Moran Lake County Park and the Santa Cruz County Sanitation Department D. A. Porath Sanitation Facility.

In order to ensure the preservation of the monarch butterfly wintering habitat at Moran Lake, private property owners must be included in the efforts to protect monarch roost areas. The plan addresses issues specific to each of the habitat areas and establishes recommendations for habitat preservation that are applicable for all properties involved.



Monarch Butterfly Cluster (Photo: Entomological Consulting Services, Ltd.) (Figure 29)

MONARCH BUTTERFLY MONITORING RECOMMENDATIONS

This report recommends the establishment of a program to monitor the monarch population at Moran Lake. It will be important to have a baseline count of the monarchs and record any changes in population because the park and habitat improvements will be phased over several decades. It is recommended that a monarch specialist/entomologist perform the monitoring according to the following guidelines:

- Butterfly counts should occur on six different occasions per year to maintain an accurate database.
- These counts should begin the first two weeks of October and continue until the first two weeks of February.
- The monitoring should include when the butterflies arrive and depart, local movement of the butterflies through the overwintering season, notes on nectar sources (i.e. status of ivy and its relationship to the tree it is climbing).
- This report recommends that an annual summary of the butterfly monitoring be submitted to the Director of the Parks Department. This will assist in maintaining consistency in the reporting over a long period of time and aid in habitat management in combination with the tree monitoring annual report.

2.1 GENERAL RECOMMENDATIONS

TREE MANAGEMENT

Given that the primary focus of management in any monarch butterfly wintering habitat must be preservation of the trees that create and protect the roost areas, management strategies must be designed to maintain:

- Grove size and spatial configuration;
- Tree density within the grove or stand;
- Upper and lower canopy densities;
- Sapling/mature tree ratios.

Equally important considerations include preservation and/or enhancement of:

- Appropriate nectar and water sources;
- Understory vegetation.

Based on the premise that most arbitrary changes in a functioning system will degrade the system rather than enhance it, the most prudent approach to the issue of tree removal and pruning in monarch butterfly wintering habitats is one of minimizing change. Trees are the most essential component of any monarch butterfly wintering habitat and as a consequence, tree loss is the greatest contributor to degradation of these habitats. In essence, trees are the habitat, thus tree loss is habitat loss. Safety pruning, rather than tree removal, should always be the first option considered in dealing with trees of concern.

In order to ensure that trees are not removed unnecessarily, a certified arborist should periodically evaluate the trees at Moran Lake to:

- Identify potentially hazardous limbs and trees;
- Assign hazard ratings to the trees;
- Recommend and prioritize actions to reduce potential hazards.

During the ensuing 3-5 years, evaluation should occur annually. Thereafter, monitoring frequency should be determined by the arborist and park manager to maintain the trees in good health and to avoid the development of safety problems.

Based on the arborist's recommendations, a monarch butterfly specialist should then examine the trees to determine what role the trees play in creating and/or protecting the monarch butterfly roost areas. Based on this analysis, the monarch butterfly specialist may suggest mitigations to reduce the impacts of unavoidable limb and tree removal.

TREE PRUNING GUIDELINES

- Hazardous limbs shall be removed with care to avoid damaging adjacent trees.

- A hazardous limb that is longer than 20-25 feet should be pruned back 15-20%.

- Pruning shall only be done between April and August with the best times occurring between April 15 and May 15 to maximize new canopy growth.

- Prior to pruning, confirm with a biologist that there are no raptors nesting in the vicinity.

2.2 GENERAL RECOMMENDATIONS

TREE REMOVAL GUIDELINES

- Confirm a monarch butterfly specialist has approved the scheduled removal.
- Hazardous trees shall be removed with care to avoid damaging adjacent trees.
- Cut wood and fallen wood shall be removed from the area to avoid infestation and propagation of insect pests such as the long-horned wood boring beetle (*Phoracantha spp.*) (Figure 30).
- After removal, monitoring of changes in the forest health and monarch butterfly habitat shall follow.
- Refer to New Tree Planting and Monitoring Guidelines for replecement guidelines.

NEW TREE PLANTING AND MONITORING GUIDELINES

- A minimum of two trees shall be planted to replace every tree removed.
- Any new tree species planted shall be from the Recommended Plant List and from the appropriate Habitat Function list. (Appendices 3.3). Follow the plans/diagrams found within Specific Recommendations for correct spatial configuration of new plantings.
- All new plantings shall receive irrigation. A temporary irrigation system should be provided to all new plantings until plants are established. There shall be routine maintenance to ensure the health of the plantings and working status of the irrigation.

Tree Felling Due to Drainage Impacts (Figure 30)

- Follow recommended tree planting detail (Figure 31).
- All new plantings shall receive periodic pruning to encourage structural development.
- All new plantings shall receive fertilizing and mulching.
- All new plantings shall receive adjusting of tree staking or herbivore protection (fencing) if used and removed at established growth stage.
- A monitoring program should be established to allow tracking of mitigation tree plantings. Each new tree should be numbered and located on a survey or map and entered into a database to track the tree's health. Trees should be inspected quarterly for the first 5 years after planting to ensure survival. Notation should be made about the habitat function the replacement trees are serving. After 5 years the monitoring can be reduced but, must be continued on an annual basis until the trees reach the height required to perform their habitat function.

  Minimum Tree Height to Reach Habitat Functions:

  - Roost tree: 50' tall
  - Primary Windbreak: 50' tall
  - Secondary Windbreak: 50' tall
  - Note: Depending on site specific conditions (ex: elevation differences), Secondary Windbreak trees may be providing windbreak before reaching 50'.

- If a tree does not survive, it should be evaluated to determine the cause of death. Any identified issues should be addressed and a new tree planted to replace the dead tree. Investigations should include review of the irrigation system, maintenance practices, soil conditions, and possibly tree species.
- This report recommends that an annual summary of the tree monitoring be submitted to the Director of the Parks Department. This will assist in maintaining consistency in the reporting over a long period of time and be helpful to Parks staff as new people take over the role of monitor.

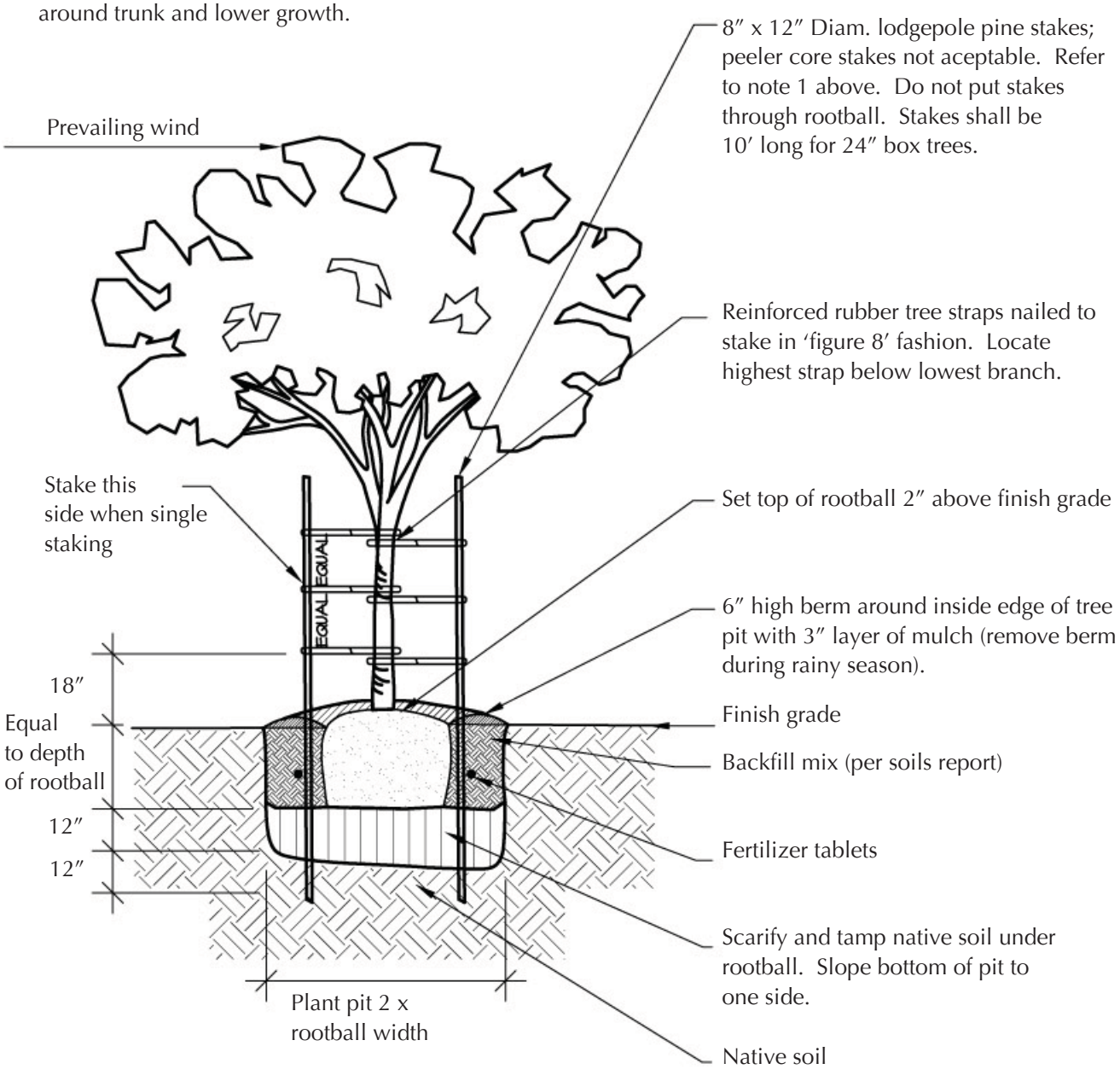
2.2 GENERAL RECOMMENDATIONS

NOTES:

1. All 15 gal. & 24″ box trees shall be double staked.

2. Remove nursery stake(s) and tags from trees upon completion of staking.

3. Provide herbivore and vandal protection around trunk and lower growth.



Typical Tree Planting Detail (Figure 31)

2.1 GENERAL RECOMMENDATIONS

UNDERSTORY VEGETATION MANAGEMENT

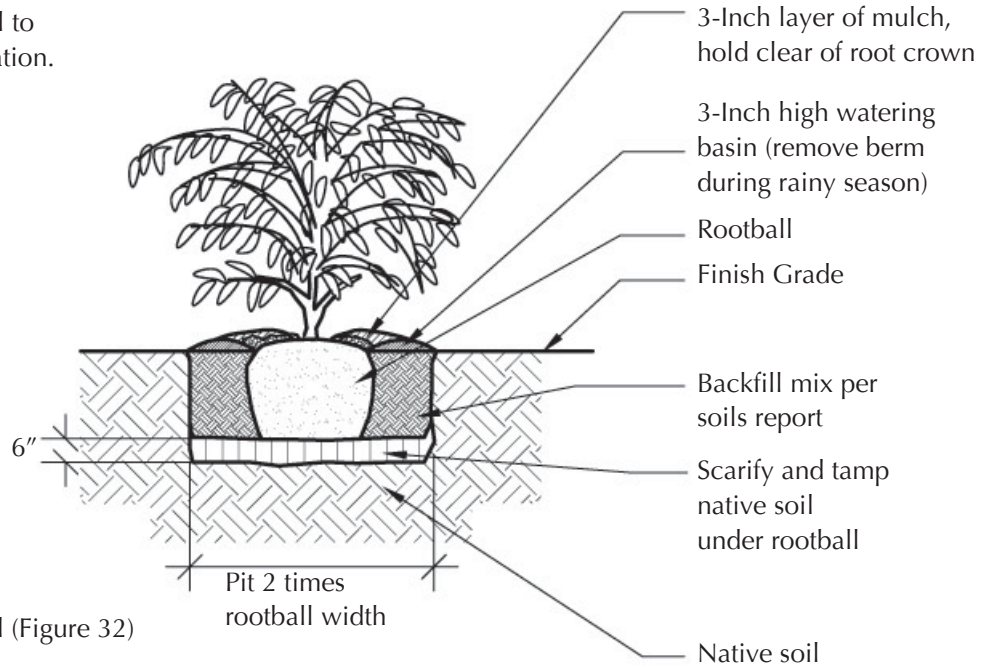
Many of the native plants that once lined the banks and upland areas adjacent to Moran Lake have been removed, disturbed, or succeeded by non-native species. The highly invasive exotics are of the most concern. To restore the lagoon and upland habitats to a more balanced condition, strategic removal of invasive non-native plants and replacement with native plants is recommended. Refer to guidelines below:

EXOTIC UNDERSTORY VEGETATION GUIDELINES

- English ivy and Cape ivy shall be selectively removed in the park and replaced with compatible native or non-invasive ornamental nectar plants.
- Ice plant, French broom and Himalayan blackberry are recommended for complete removal.
- Maintain exotic species from escaping to private properties or into Moran lake.
- Maintain exotic species from overtaking newly planted trees and shrubs.
- An exotic species removal phasing plan shall be established by Parks staff.
- Erosion control methods shall be in place after removal to prevent slope destabilization.

PLANTING GUIDELINES

- Refer to the Recommended Plant LIst (Appendices 3.3) for new species to plant.
- Take a soil test from each of the (8) habitat areas to receive new planting and send to a soil laboratory for an agricultural suitability analysis.
- Amend soil in each area to receive new planting per recommendations of soil report for that specific habitat area (see Figure 9 on page 10).
- Provide temporary irrigation to all new plantings and monitor moisture content of soil to keep moist, but not saturated until plantings are established.
- Follow recommended shrub planting detail. (Figure 32).
- Provide 3-inch layer of mulch around new plantings, hold clear of root crown.
- Schedule weekly maintenance visits to adjust and monitor the irrigation system, keep invasive species from overgrowing new plantings, and to monitor the health of the new plantings.



Typcial Shrub Planting Detail (Figure 32)

2.1 GENERAL RECOMMENDATIONS

RESTORATION OF MORAN CREEK RIPARIAN CORRIDOR

Development in the Moran Lake watershed has significantly reduced the Moran Creek riparian corridor and floodplain. At many locations the Moran Creek channel has been placed in underground culverts (Figure 34). In other areas development has encroached into the riparian corridor eliminating the low flood terrace and riparian vegetation that plays an important role in natural stream function (Figures 35-36). It would benefit the overall condition of Moran Lake to restore the floodplain and riparian corridor to a more natural function to the extent practicable. Recommendations to improve the watershed and habitat quality include:

- Controlling storm-water runoff and associated non-point source pollution within the watershed with the use of landscape based Best Management Practices (BMPs) such as bioretention, vegetated swales and constructed wetlands (Figure 33). Refer to Appendix 3.4 for BMP technical resources.
- Daylighting the stream.
- Widening the stream corridor to provide a functional riparian buffer.

Example of Bioswale in Parking Lot (UCSC Seymour Marine Discovery Center) (Figure 33)

Existing Drainage Channel Near Lode Street (Figure 34)

Existing Conditions of Lake (Figure 35)

Existing Conditions at South Creekside (Figure 36)

2.1 GENERAL RECOMMENDATIONS

PUBLIC AWARENESS & INVOLVEMENT

Currently, there are several groups working to clean the lagoon corridor and monitor water quality. These groups could work in unison to help restore the habitat and monitor the long term success of the area as habitat for the butterflies and other wildlife. Additional public educational workshops about Moran Lake would also help strengthen a commitment from residents within the Moran Lake watershed to protect the lagoon and butterfly habitat.

Applicable county agencies should work together with a certified arborist and monarch butterfly specialist to monitor the plantings, vegetation enhancements and drainage improvements on a regular basis. A collaborative approach may allow for shared funding on projects that provide multiple benefits. Additionally, private funding sources can be solicited and encouraged to support collaborative programs, particularly when the community is a partner in the restoration effort.

The following are suggestions for public involvement, thereby increasing awareness and potentially providing valuable time and effort in park maintenance:

- Develop interpretive brochures for neighbors and community
- Establish neighborhood “watch dog” group
- Provide information regarding related programs such as “Monarch Lab” and “Project Monarch”
- Provide information for planting trees and plants that support monarch butterflies
- Organize a watershed group through the California Coordinated Resource Management and Planning (CRMP) process
- Expand volunteer efforts to monitor water quality and maintain records
- Organize community volunteer stream clean up days

Community Participation (Figure 37)

2.2 SPECIFIC RECOMMENDATIONS

Habitat Management & Park Improvements Map (Figure 38)

2.2 SPECIFIC RECOMMENDATIONS

#1 – BANK STABILIZATION

- **Regrade steep and eroding banks and plant with appropriate native species.**
- **Planting at water edges must be tolerant of occasional submergence and salt exposure.**

Undertaking a bank stabilization project is important to protect the bicycle path and to reduce further erosion, restore the bank to a more natural configuration and to restore habitat value to the disturbed area.

The existing steep bank should be re-graded from a 2.5:1 to 3:1 slope and be planted with native brackish wetland species. The upper bank should be planted with salt tolerant upland herb and shrub species with the upland flat planted with scattered trees, herbs, and grasses. This design would have the benefits of creating additional wildlife habitat while reducing or eliminating the current rate of bank erosion. In order to protect the bicycle path and adjacent upland, the restored bank may need to be rebuilt in a westerly direction recapturing the bank lost to erosion.

Existing Bicycle Path Compromised by Erosion (Figure 39)

Existing Conditions of Bank at Bicycle Path (Figure 40)

2.3 SPECIFIC RECOMMENDATIONS

#2 – SOUTHEAST GROVE & MORAN WAY WINDROW

- **Establish transitional planting from Eucalyptus trees to emergent zone**

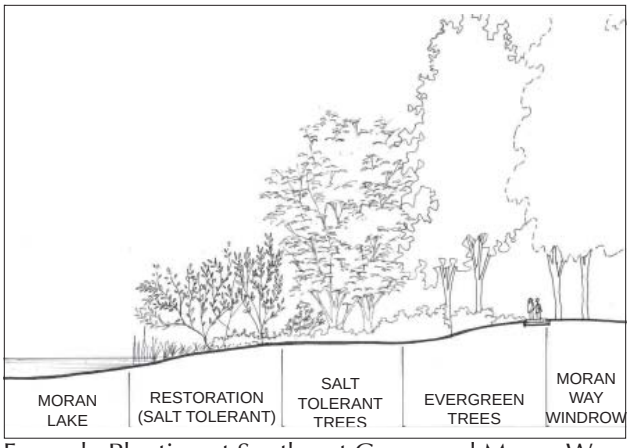
- **Trees to be field located, coordinate with neighbors to strategically locate trees**

The Moran Way windrow trees, and the trees of the southeast grove as a whole, provide critical south wind screening for the lake and gallery forest areas to the north, including the lakeside autumnal roost areas. The southeast grove also provides temporary (refuge/bivouac) habitat for monarchs migrating along the coastal flyway.

The stability of this wind barrier could be improved by planting salt tolerant eucalyptus (e.g., swamp mahogany, *Eucalyptus robustus*) on the flood plain along the northern edge of the windrow trees (Figure 41). Other tall evergreen species (e.g., Sydney blue gum, *Eucalyptus saligna*) would also be appropriate; however, wind-blown salt-spray and salt concentrations in soil and ground water in this area are likely to limit the survival of many otherwise suitable species (e.g., coast redwood, alder and willow).

The effectiveness of the southeast wind screen could also be improved by planting tall-growing, salt-tolerant, evergreen species on the flood plain along the eastern border of the park. Historically, this area supported a windrow of blue gum eucalyptus that extended from the southeast grove northward to the gallery forest trees on the east shore of the lake.

Since the initial preparation of the habitat management plan, the County Redevelopment Agency has purchased parcel APN 028-302-04 (see Figure 3) from a private property owner for inclusion as park and recreation use in conjunction with other parcels at Moran Lake Park. As there are a number of eucalyptus trees on this parcel, it is appropriate to include the findings and recommendation of the Butterfly Habitat Management Plan as they may apply to this parcel. At this time, there are no proposals for improvements at this site and any proposal would be subject to Planning Department permit requirements and community input process.



Example Planting at Southeast Grove and Moran Way Windrow (Figure 41)

Existing Conditions at Southeast Grove and Moran Way Windrow (Figure 42)

2.3 SPECIFIC RECOMMENDATIONS

#3 – UNDERSTORY VEGETATION

- **Develop a planting plan for areas around the parking lot, lake, and picnic facilities to enhance aesthetic and habitat value of park landscape.**

- **Plant native nectar source vegetation. Restrict planting of new exotic vegetation.**

Future planting plans, plant replacements, and plant infill for the public properties surrounding Moran Lake are to be chosen from the plant list provided in Appendix 3.3. Neighbors should be encouraged to plant native nectar producing vegetation in their gardens. A demonstration garden can be planted to show neighbors to how use such plants in their landscape.

Salvia mellifera (Black Sage) (Figure 44)

*Achillea millefolium (*Common Yarrow) (Figure 45)

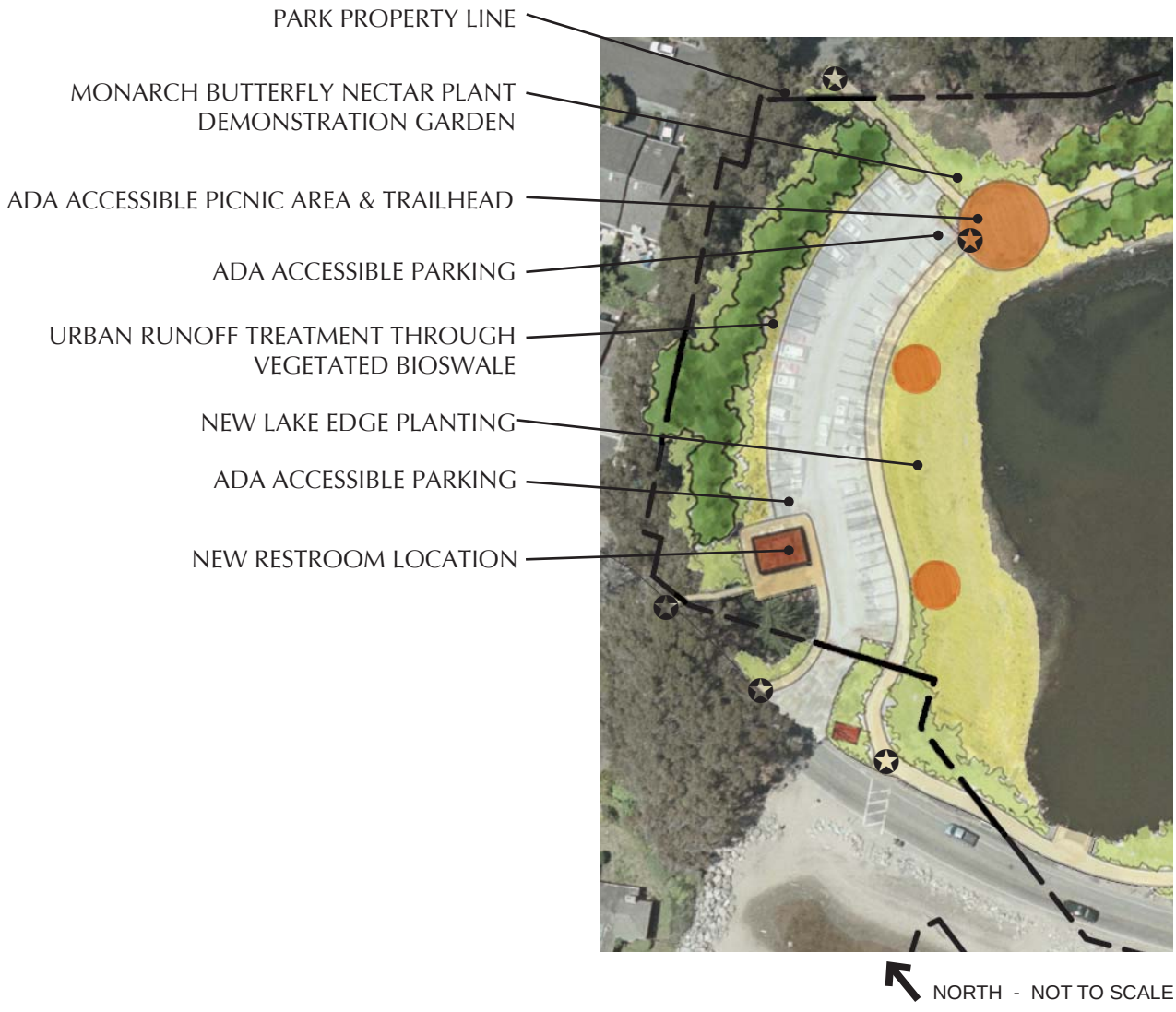
Ceanothus spp. (California Lilac) (Figure 43)

Rubus ursinus (California Blackberry) (Figure 46)

2.3 SPECIFIC RECOMMENDATIONS

#4 – PARK ACCESS IMPROVEMENTS

- **Improve parking configuration**
- **Provide ADA access to picnic areas and trail**
- **Provide new ADA accessible restrooms**
- **Improve entry signage**
- **Establish demonstrative urban runoff mitigation features**



Conceptual Park Access Improvement Plan (Figure 47)

2.3 SPECIFIC RECOMMENDATIONS

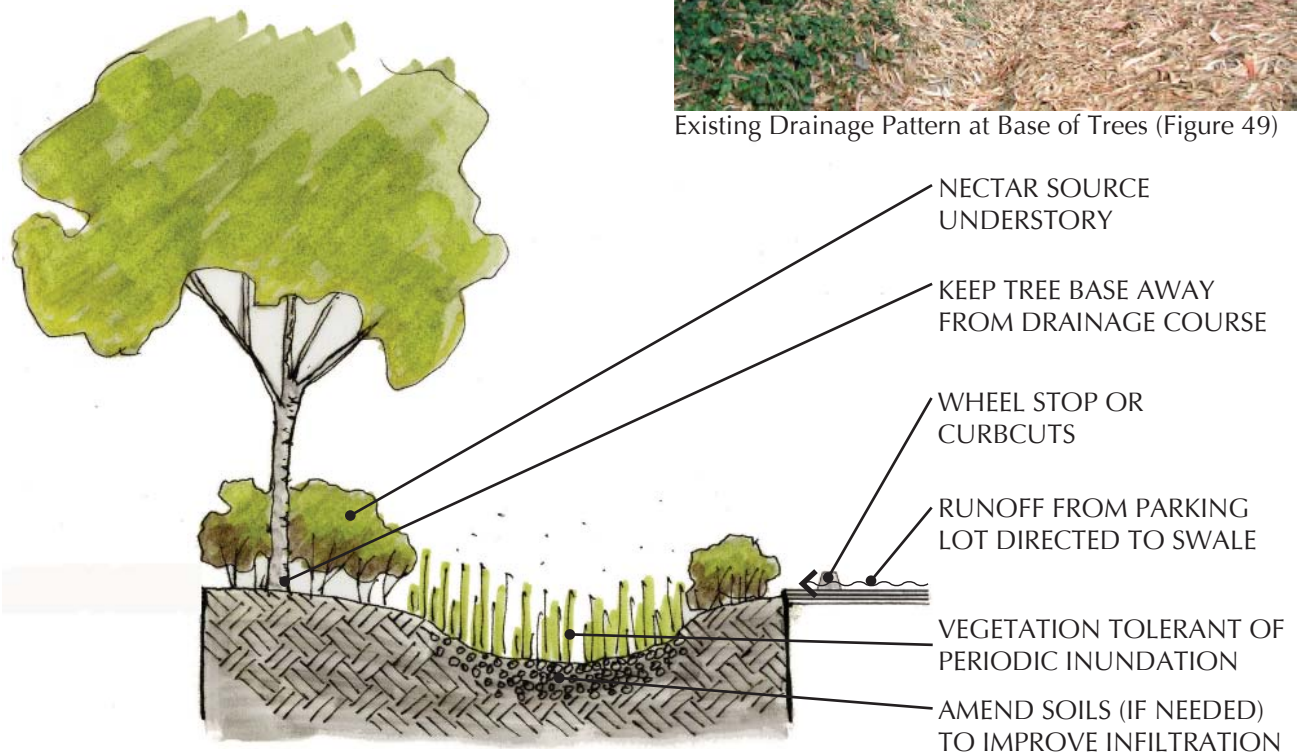
#5– SOUTHWEST WINDROW

- **Improve and maintain existing drainage**
- **Monitor for selective pruning of Eucalyptus**

This row of trees provides important west wind screening for the parking area at the southwest end of the park and provides secondary wind protection for trees to the north along Peralta Way and to the east along Moran Way. Because visitor activities are more concentrated in the parking area than in any other area of the park, it is particularly important that these trees remain in good health. Periodic safety pruning and selective removal of dead limbs and hazardous trees under the direction of a certified arborist, should be scheduled in order to ensure human safety in this area. Redirecting drainage swales away from the base of these trees is also essential for minimizing tree losses due to soil and/or root failure (Figure 50).

Existing Path Connecting East Cliff and Parking Lot (Figure 48)

Existing Drainage Pattern at Base of Trees (Figure 49)



Vegetated Bioswale (Figure 50)

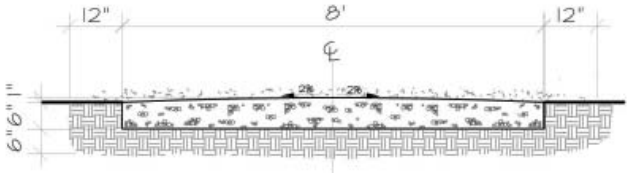
2.3 SPECIFIC RECOMMENDATIONS

#6 – PUBLIC PATH & PICNIC AREA

- **Stabilize banks, especially under and along trail**
- **Provide boardwalks over proposed swales**
- **Stabilize trail as shown in Figure 51**
- **Improve picnic facilities**
- **ADA accessibility of picnic areas and trail**

Erosion of the lake and creek banks and poorly directed runoff are affecting the stability and accessibility of the trail system throughout the park. A raised boardwalk is recommended for portions of the trail to allow drainage to flow under the boardwalk and to minimize impacts to the existing tree roots.

The existing picnic areas are to be improved by providing universal accessibility to ADA compliant picnic tables and benches (Figure 52).



Detail of new trail construction (mulch over aggregate base (Figure 51)

#7 – INTERPRETIVE ELEMENTS

- **Develop an interpretive node at the Nectar Plant Demonstration Garden to educate park users about environmental issues pertinent to the site**

The existing trails within the Moran Lake County Park are well used and present an opportunity to incorporate interpretive signage. Possible signing themes include:

- Watershed definition and how to maintain a healthy watershed;
- Lagoon wetland functions in maintaining/ enhancing water quality;
- Wildlife species information, including habitat and species' life cycles;
- Monarch butterfly habitat, migration, winter roosting, and importance of specific microclimate conditions;
- Monarch butterfly nectar plant species' identification and recognition.

As with all site ammenities, signs should be designed to minimize damage from salt air and vandalism.

Nectar Plant Demonstration Garden and Picnic Area (Figure 52)

2.3 SPECIFIC RECOMMENDATIONS

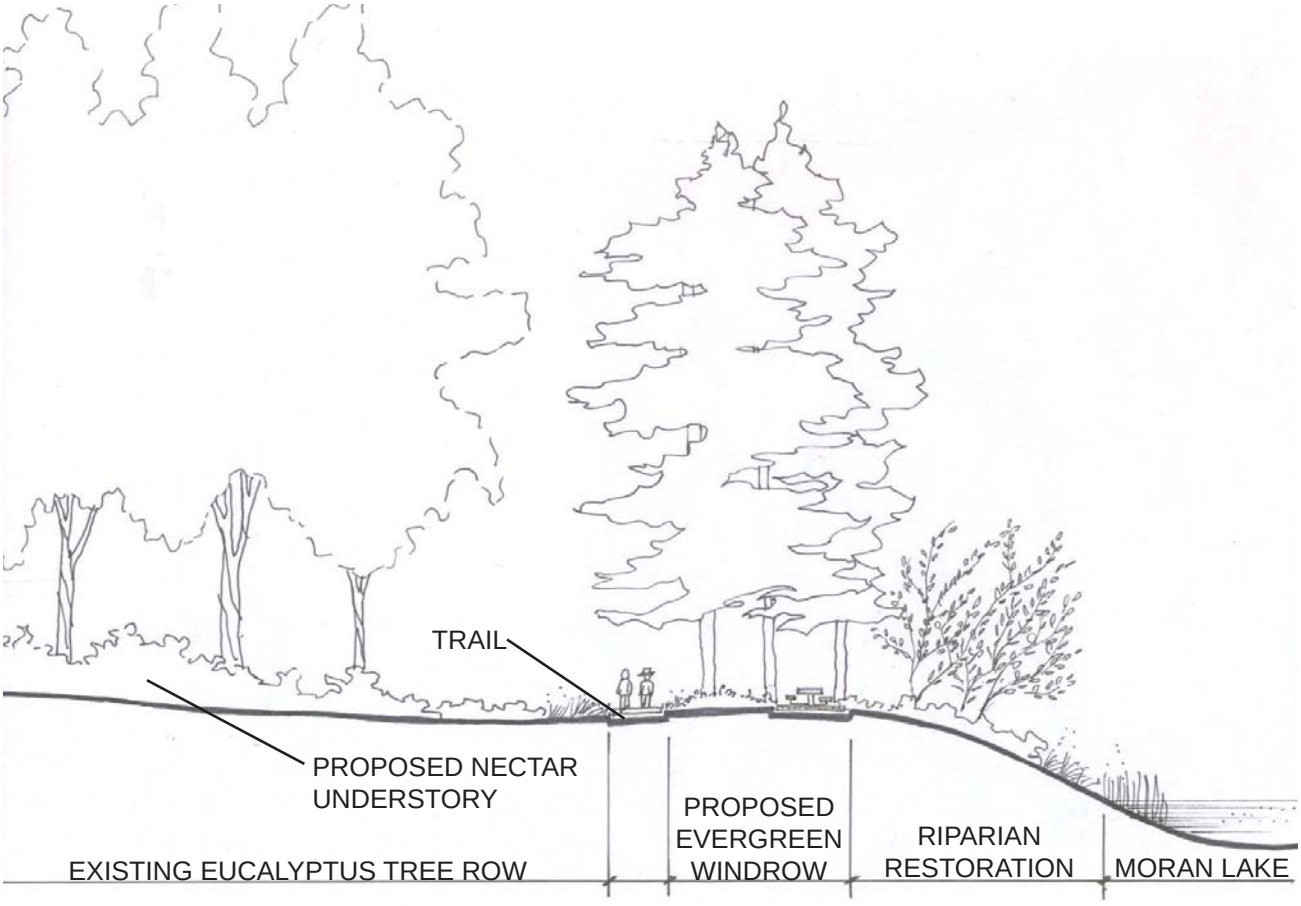
#8 – PERALTA WAY WINDROW

- **Eliminate limbing up of Eucalyptus**
- **Evergreen windrow trees to be planted**
- **Develop and implement planting plan for understory and nectar-source landscaping along edge of tree row and into park**

This windrow of blue-gum eucalyptus contributes wind protection for the lakeside autumnal roost areas by acting as an initial south and west windbreak for the gallery forest area. The effectiveness of this wind barrier could be substantially improved by planting lower-growing trees such as Monterey cypress (*Cupressus macrocarpa*) along the southern and eastern margins of the windrow and along the adjacent lake shore east of the footpath (Figure 53).

Winter storm-water drainage problems in this area are currently threatening the stability of the eucalyptus trees by periodically creating saturated soil conditions that lead to soil failure and loss of trees due to wind-throw. These drainage problems should be rectified before new trees are planted in this area. In the short-term, storm-water runoff should be re-routed by surface grading to drain the swale and prevent pooling. However, it is apparent that drainage problems in this area must ultimately be resolved by channeling neighborhood street runoff into storm drains that convey the water underground into the lake.

Tall-growing salt-tolerant evergreen trees should also be planted along the southern portion of the western lakeshore adjacent to Peralta Way to help deflect wind that would otherwise blow northward through the gallery forest.

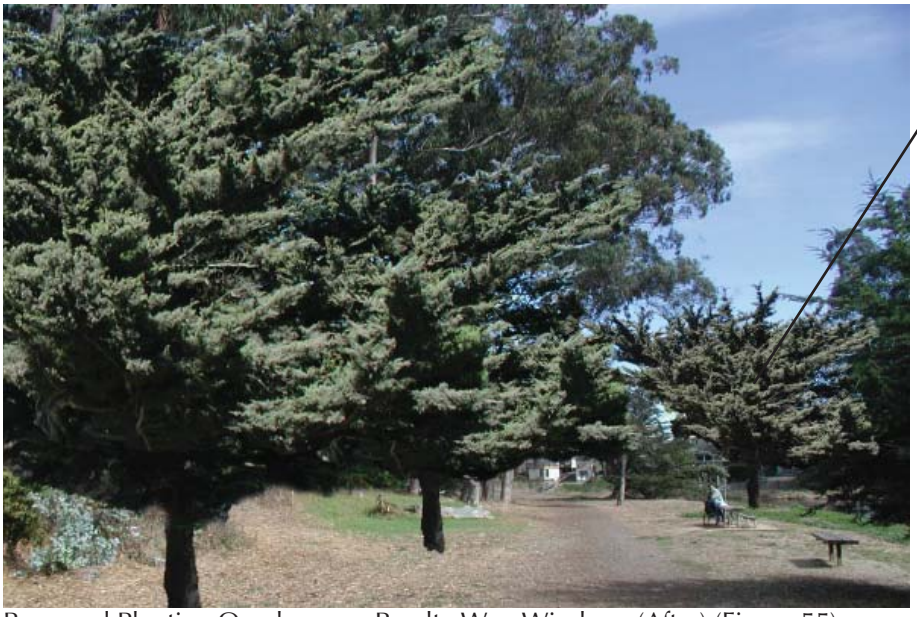


Section - Proposed Windrow at Peralta Way (Figure 53)

2.3 SPECIFIC RECOMMENDATIONS

#8 – PERALTA WAY WINDROW

Existing Conditions near Peralta Way Windrow (Before) (Figure 54)



Proposed Planting Overlay near Peralta Way Windrow (After) (Figure 55)

2.3 SPECIFIC RECOMMENDATIONS

#9 – SOUTH LAKESIDE (SOUTH GALLERY FOREST)

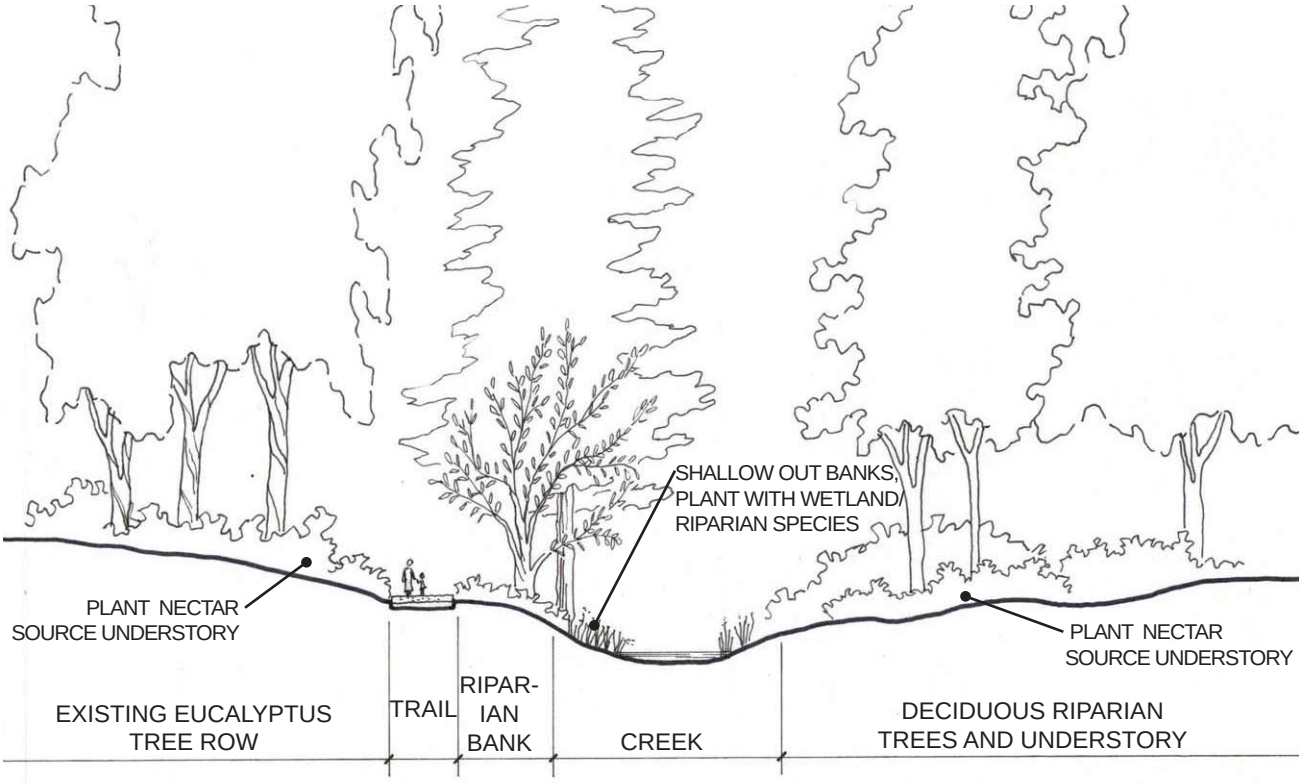
- **Control urban runoff and ponding at base of Eucalyptus**

- **Develop and implement planting plan for landscape at tree margins for understory and windscreen protection**

The gallery forest at Moran Lake is created by the two rows (windrows) of trees that line the east and west shorelines of the lake between Lakeview and Placer Streets. The gallery forest protects and supports the two lakeside roost areas (north and south lakeside roost areas).

Arbitrary tree removals, and losses due to wind-throw during the winter of 1997-98, have reduced the wind protection that these trees once provided for the autumnal roost area at the north end of the gallery forest. A mixture of flooded gum eucalyptus and coast redwood has been planted at the south margin of the north lakeside roost area as partial mitigation for these losses. These trees are now showing good growth rates, but because of the density of this planting, the trees are now beginning to compete with each other for space and will soon require thinning in order to maintain good growth rates. Since these trees are still relatively small (sapling size), it should be possible to selectively remove trees from this area and replant them elsewhere in the park.

Long range plans should include the addition of trees and understory planting on the east side of the creek after the first phase of park improvement plans have been installed (Figure 56).



Section - South Lakeside (Figure 56)

2.3 SPECIFIC RECOMMENDATIONS

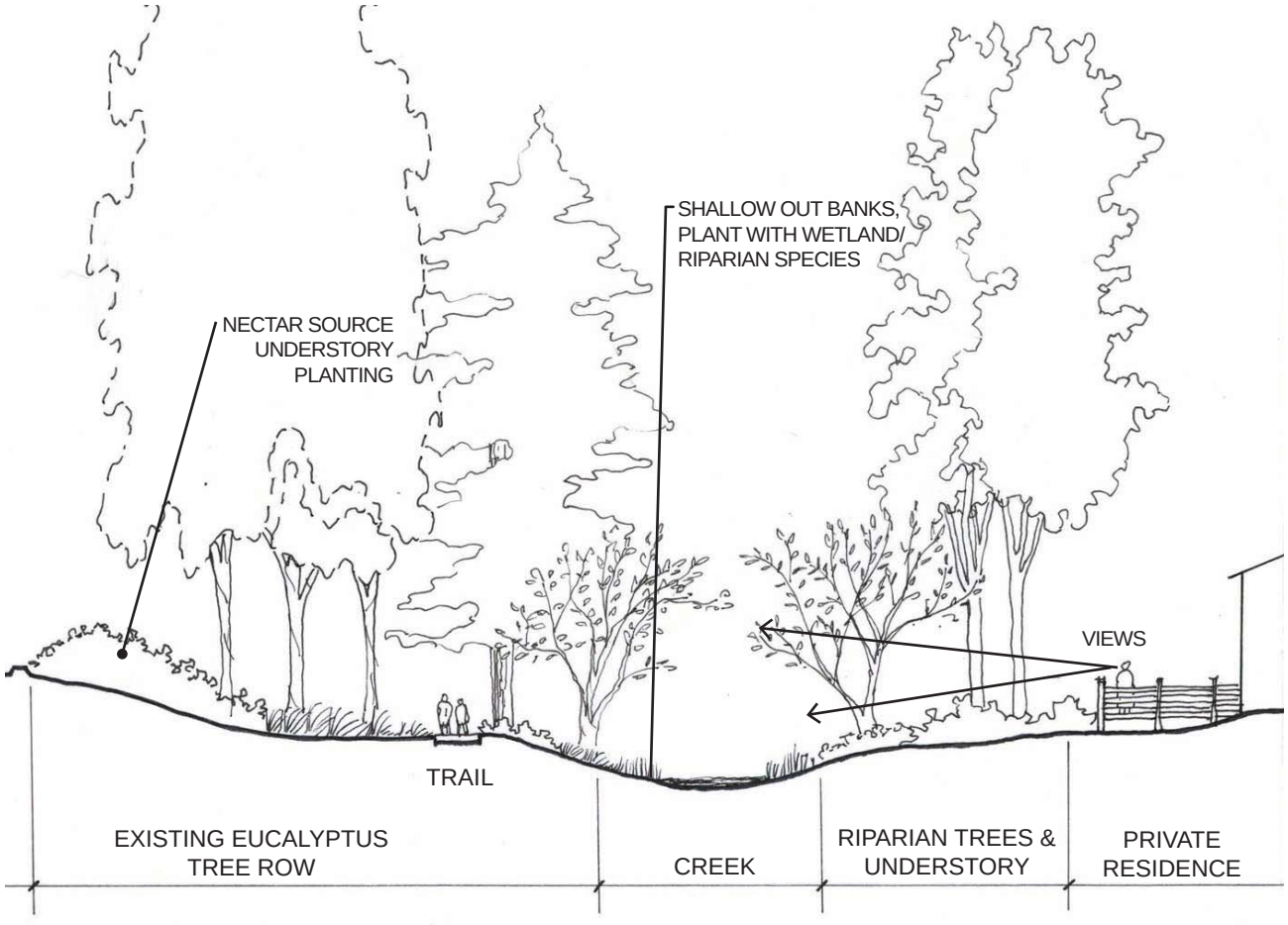
#10 – NORTH LAKESIDE (NORTH GALLERY FOREST)

- **Control urban runoff from the D. A. Porath Sanitation Facility**
- **Implement windscreen restoration planting to establish North Lakeside Roost Area and Roost Areas surrounding the D. A. Porath Sanitation Facility**
- **Provide nectar understory plants**

Mid-level evergreen trees should be planted to increase the buffer from the winds coming from the northeast. This will help create a pool of still air in this area and thus improve conditions for roosting monarchs.

This area is close to the roosting area and has ample sun exposure to accomodate many of the native understory nectar producing plants. These plants should be added to this area to provide additional sources for the monarchs.

Long range plans should include the addition of trees and understory planting on the east side of the creek after the first phase of park improvement plans have been installed (Figure 57).

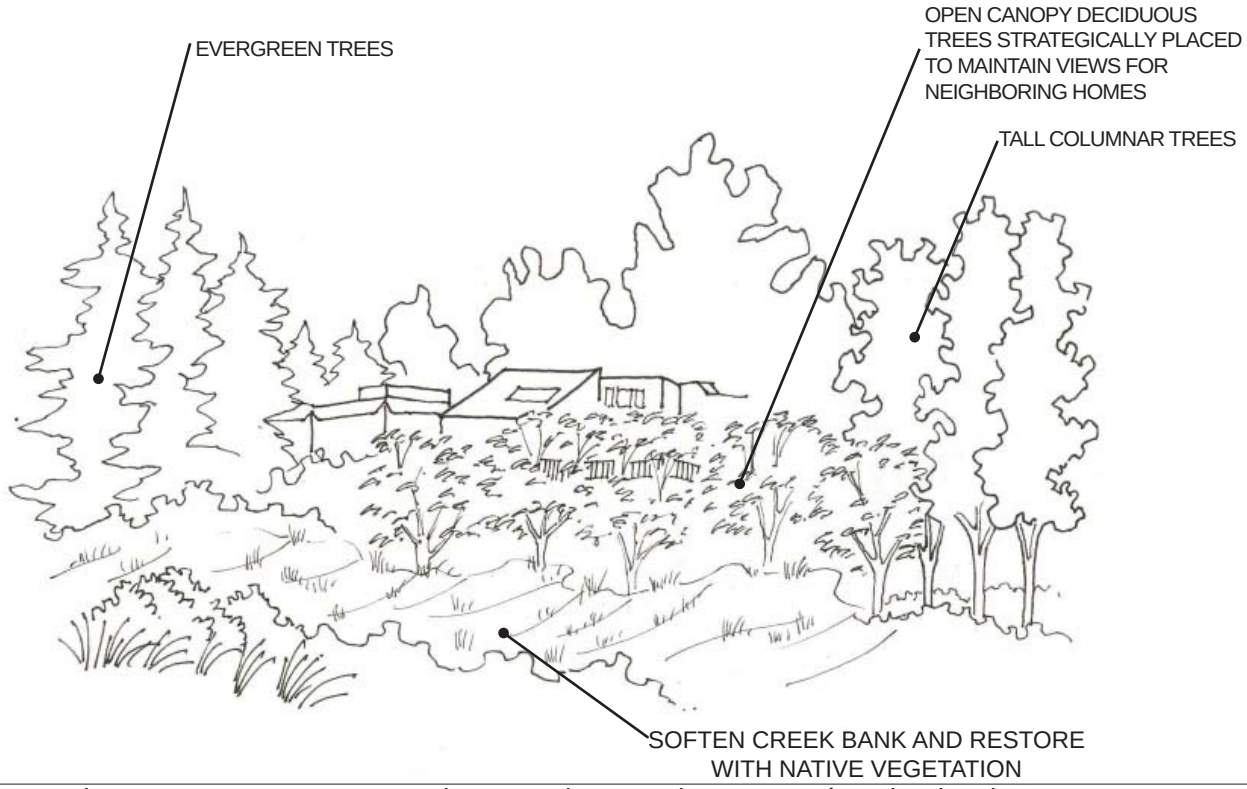


Section - North Lakeside (Figure 57)

2.3 SPECIFIC RECOMMENDATIONS

#10 – NORTH LAKESIDE (NORTH GALLERY FOREST)

Existing Conditions Northeast of North Lakeside Roost Area (Figure 58)



Proposed Long Range Improvement Northeast Windscreen Enhancement of North Lakeside Roost Area (Figure 59)

2.3 SPECIFIC RECOMMENDATIONS

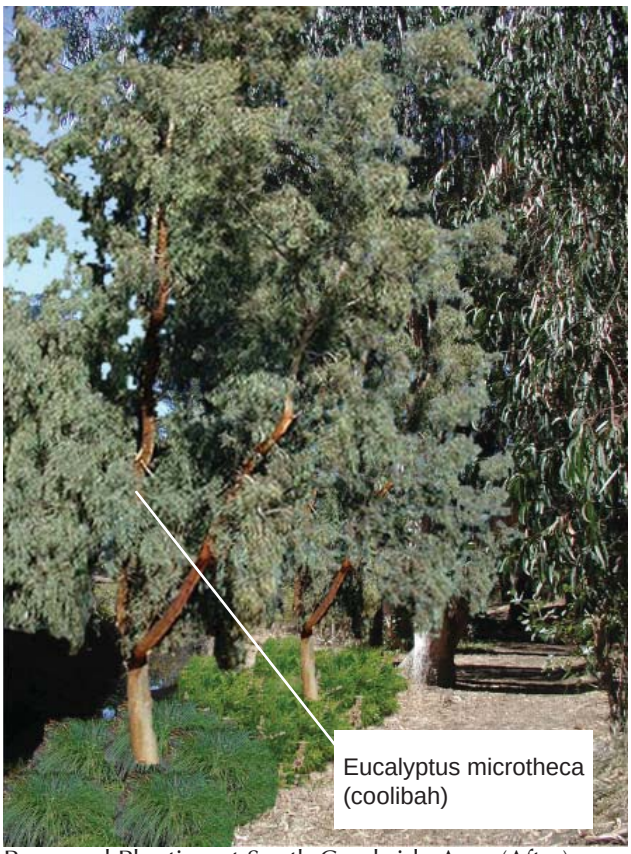
#11 - SOUTH CREEKSIDE

- **Prune selective branches that are of particular danger (20 feet long or more).**
- **Exotic understory nectar species shall be controlled and selectively removed as replacement nectar plants demonstrate that they are providing the food supply necessary for overwintering monarchs.**
- **Plant new trees where sunlight and open space permit planting. Refer to Figure 62 for approximate locations and species.**

The South Creekside area is critical habitat for the butterflies. There is a public access trail that is heavily used and presents liability issues with the trees. There are several trees of poor structure and overhanging limbs that are a threat to public safety (Figure 61). However, they are part of an important dynamic of the butterfly habitat. New trees of better structure should be planted in open areas to allow future pruning and/or removal of the unsafe trees and will help replace the windbreak lost after trees were removed in 1998-1999.

Dead or Dying Branches to be Removed (Figure 61)

Existing Conditions at South Creekside Area (Before) (Figure 60)



Proposed Planting at South Creekside Area (After) (Figure 62)

2.3 SPECIFIC RECOMMENDATIONS

#12 – NORTH CREEKSIDE

- **Prune selective branches that are of particular danger (20 feet long or more).**

- **Exotic understory nectar species shall be controlled and selectively removed as replacement nectar plants demonstrate that they are providing the food supply necessary for overwintering monarchs.**

- **Plant new trees where sunlight and open space permit planting. Refer to Figure 64 for approximate locations and species.**

The North Creekside area is an extension of the habitat found in the South Creekside. New trees of better structure should be planted in open areas to allow future pruning and/or removal of the unsafe trees.

Existing Conditions at North Creekside Area (Before) (Figure 63)

Proposed Planting Overlay at North Creekside Area (After) (Figure 64)

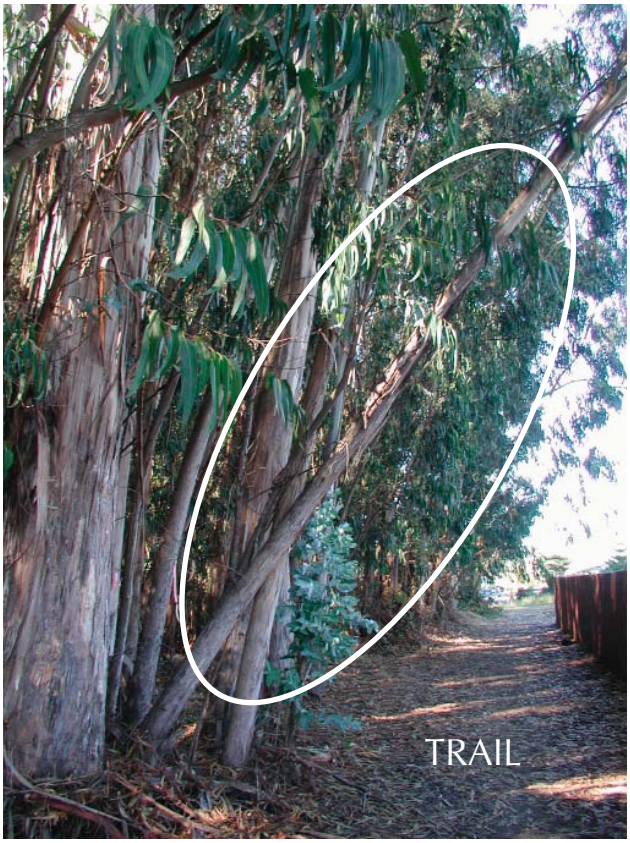
2.3 SPECIFIC RECOMMENDATIONS

#13 – PRIMARY ROOSTING AREA

- **Selective crown height reduction and branch end weight reduction pruning on trees tagged by James P. Allen & Associates. Refer to additional recommendations in description.**
- **Plant new trees where sunlight and open space permit planting.**
- **As the new trees begin to reach heights of 25-30' tall, individual trees that pose the greatest risk can be removed.**
- **Exotic understory nectar species shall be controlled and selectively removed as replacement nectar plants demonstrate that they are providing the food supply necessary for overwintering monarchs.**

This area serves as the primary roost areas for the butterflies. There is a dirt road bisecting the main roost area that serves as access for the Sanitation District to reach their storage yard. Between the north side of the roost area and the fence of the storage yard is an access road/trail. There are overhanging branches that pose a safety threat to the public and the Sanitation District employees that use this access road/trail. Selective pruning of overhanging branches may be done within the established timelines. (Figure 65).

James P. Allen & Associates (Arborists) have prepared a "Tree Risk Management Plan" (Dated October 16, 2003) for the trees in this area. Many trees have been numbered and tagged to receive either crown height reduction pruning or branch end weight reduction pruning. This report recommends the pruning occur in phases over three to five years. Concurrently a tree replacement program should begin. Part of the work performed by Allen's report has already begun this process. Several *Umbellularia californica* (California bay tree) and *Eucalyptus sideroxylon* (red ironbark) have already been planted and seem to be doing well. However, this report does not recommend planting *Eucalyptus sideroxylon* (red ironbark). A continuation of new plantings should be done in stages while selective pruning is done to minimize the amount of risk.



Branch to be Removed (Figure 65)


Cape Ivy Growing in Eucalyptus Tree to Remain (Figure 66)

2.3 SPECIFIC RECOMMENDATIONS

#13 – PRIMARY ROOSTING AREA

Existing Conditions at Primary Roosting Area (Before) (Figure 67)

Proposed Planting Overlay at Primary Roosting Area (After) (Figure 68)

2.3 SPECIFIC RECOMMENDATIONS

#14 – WIND BUFFER AND FIELD

- **Selective and minimal drop-crotch pruning of branches that pose a risk to the neighboring private properties and Lode Street.**
- **Plant new trees where sunlight and open space permit planting.**
- **Remove exotic understory species (French broom).**
- **Plant understory nectar plants from the Recommended Plant List.**

This portion of the forest is intersected by the entrance to the D. A. Porath Sanitation Facility on Lode Street. Tree hazards include falling branches or unstable trees.

Removal of exotic understory species (e.g. French broom) is acceptable in these areas, as butterflies do not seek nectar in this part of the forest (Figure 69).

Drainage is coming from off site locations resulting in ditches that cut through the field in several locations and then flow into the drainage channel that surrounds the D. A. Porath Sanitation Facility (Figure 70).


Existing French Broom to be Removed (Figure 69)


Existing Drainage Channel (Figure 70)

2.3 SPECIFIC RECOMMENDATIONS

#15 – CRITICAL WINDBREAK

- **Stabilize existing drainage channel by shallowing banks to a 3:1 slope where possible and installing erosion control blanket, if necessary. Refer to Figure 73.**

- **Selective and minimal drop-crotch pruning of branches that pose a risk to the neighboring private properties.**

- **Remove dead coast redwood trees and other recently planted dead or dying plants (Figure 71).**

- **Plant new trees where there are opportunities. Refer to Figure 75 for approximate locations and species.**

- **Do not remove existing trees until the replacement trees have reached a height of 50 feet in order to maintain a solid windbreak.**

- **Exotic understory nectar species shall be controlled and selectively removed as replacement nectar plants demonstrate that they are providing the food supply necessary for overwintering monarchs.**

Recently Planted Coast Redwood Tree - Dead (Figure 71)

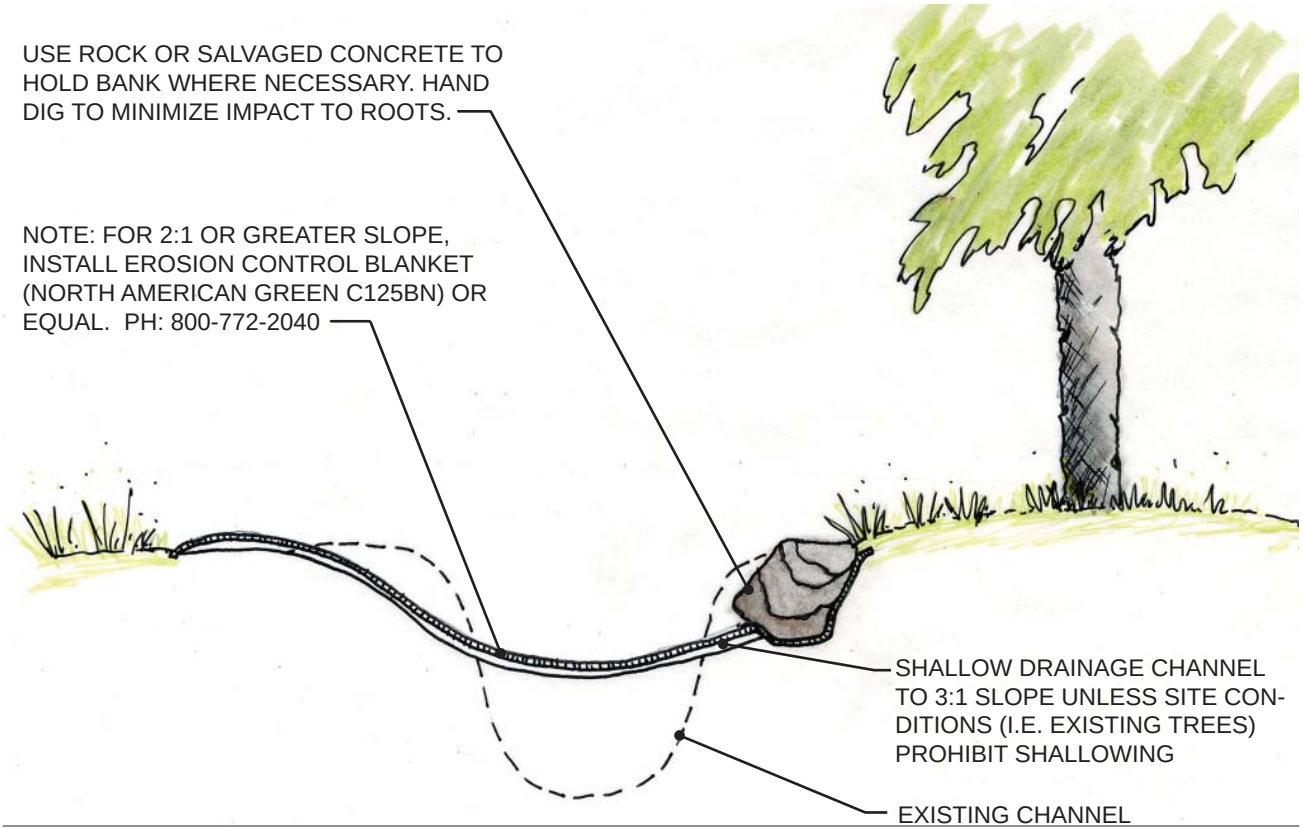
This area provides essential windbreak, sheltering the primary roost area from the south easterly winds. These trees are located in a narrow strip between the corp yard of the D. A. Porath Sanitation Facility and the property line. Several of the trees have overhanging branches onto the private properties directly to the southwest that present a safety hazard. A drainage channel runs through the area and empties the runoff into Moran Lake. If improvements are not made, erosion of the ditch will continue and eventually undermine the stability of the already declining forest.

The health of these trees is declining and in order to maintain the essential windbreak for the butterfly habitat a tree replacement program should be started. There is evidence that this was attempted in the past. There are several coast redwoods that have been planted sometime in the last several years, but they have all died. It doesn't appear that there was irrigation to the trees which could be the reason for failure.

2.3 SPECIFIC RECOMMENDATIONS

#15 – CRITICAL WINDBREAK

Existing Drainage Channel at Critical Windbreak (Figure 72)



Proposed Improvements to Drainage at Channel, Typical (Figure 73)

2.3 SPECIFIC RECOMMENDATIONS

#15 – CRITICAL WINDBREAK

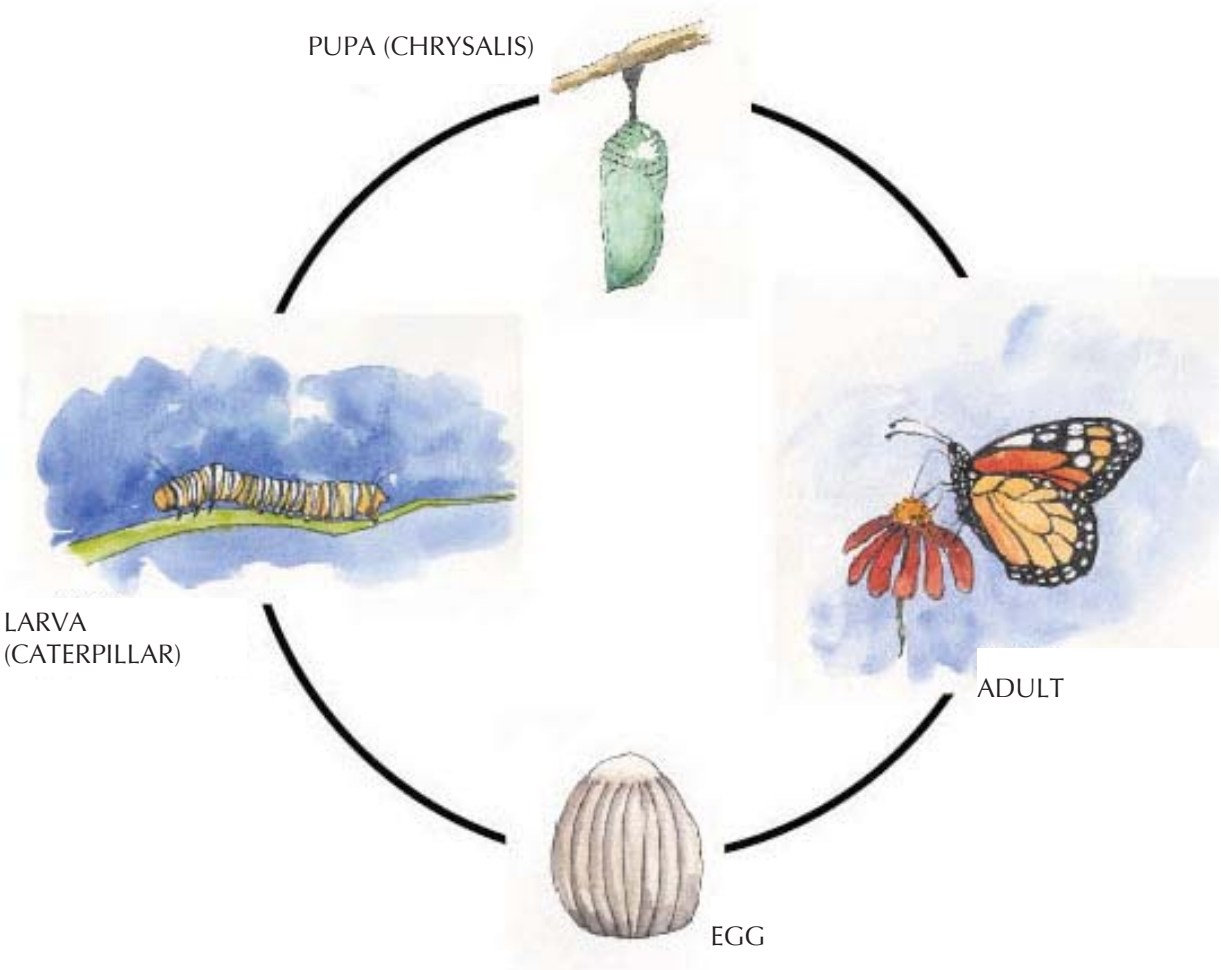
Existing Conditions at Critical Windbreak (Before) (Figure 74)

Proposed Planting Overlay at Critical Windbreak (After) (Figure 75)

APPENDICES
3.1 MONARCH BUTTERFLY NATURAL HISTORY

LIFE CYCLE OF THE MONARCH BUTTERFLY

The life cycle of the monarch (*Danaus plexippus* L.) consists of four morphologically distinct stages: egg, larva (caterpillar), pupa (chrysalis) and adult. Monarchs are ectothermic ("cold blooded") animals, thus their activity and metabolism vary in accord with their body temperature, which is largely dependent on the heat they gain from their environment. Under ideal temperature conditions, monarchs spend around 4 days in the egg stage, 14 days as caterpillars, 10 days as pupae and from 1 to 9 months as adults. The variation in adult life depends on whether the butterflies become reproductive immediately (in which case they live 1-2 months as adults) or migrate, overwinter and then become reproductive (in which case they live approximately 8-9 months as adults). Monarch adults that emerge from August through October typically migrate and overwinter before becoming reproductive the following spring.



APPENDICES
3.1 MONARCH BUTTERFLY NATURAL HISTORY

MONARCH BUTTERFLY LIFE HISTORY

The life history of the monarch butterfly can be divided into two temporally defined periods: a spring/summer reproductive period and a fall/winter non-reproductive (wintering) period. During the spring and summer, monarchs exploit the widely distributed North American milkweed flora (Asclepias spp.) as food for their larvae. In the fall, the adult butterflies that are produced during the latter part of summer migrate to wintering habitats in coastal California or central Mexico to spend the winter months.

The availability of overwintering habitats is particularly important for monarchs, since they are unable to survive prolonged periods of freezing temperature in any stage of their life cycle. Thus, in order to exploit the North American milkweed flora during the spring and summer, monarchs must migrate to warmer climates to overwinter (October through February). As is the case with other migratory animals, both the breeding grounds and wintering habitats of the monarchs are crucial in the maintenance of viable populations.

Monarch survival during the winter depends on their ability to find habitats where they can avoid physical damage from weather and predators, while optimizing utilization of their limited fat reserves. Since they are ectothermic animals, monarch activity is largely a function of body temperature which, in-turn, is mainly a function of ambient air temperature and exposure to sunlight (insolation). During periods of low temperature (<55 degrees F), monarchs must roost in wind protected locations that provide some periodic exposure to sunlight. During periods of warm weather they seek cool, shady roost areas in order to keep their metabolic activity levels low enough to conserve their limited fat reserves.

Thus, monarch survival through the wintering period is primarily a function of being able to find a wind protected habitat, with suitable microclimatic conditions, that is sufficiently heterogeneous to permit shifts of roost location in accord with prevailing weather conditions and seasonal variation in insolation. In California, such environments are typically found in coastal eucalyptus groves.

Prior to the decimation of the coastal forests, woodlands and riparian habitats that accompanied the invasion of California during and after the "gold rush" period (1850-1870), monarchs are thought to have utilized areas of Monterey pine forest and various wind-sheltered riparian plant communities as wintering habitat. Although eucalyptus groves are quite common along the coast of California, very few of the groves are utilized by monarchs as wintering habitats. The specific range of environmental conditions that the monarchs seek is apparently only rarely realized in nature.

CONSERVATION STATUS

Wintering habitats, because of their narrow distribution and relative rarity - in comparison to the broad geographic range of the summer breeding grounds - are the "Achilles' heel" of the monarch migratory phenomenon. Loss of these habitats could result in a complete collapse of the annual migration cycle and would vastly reduce the numbers of monarchs in North America. As human population pressures continue to increase the frequency of wintering habitat degradation and destruction, the success of the monarch's annual migration increasingly requires active conservation of overwintering habitats both in Mexico and along the California coast.

Although monarchs, as a species, are not currently threatened on a global scale—because of their broad distribution—they are recognized as a "species of concern" by the California Department of Fish and Game (CNDDB Rank: G5S3) because of the restricted range and relative rarity of their wintering habitats. Monarch butterfly wintering habitats are also legally protected as environmentally sensitive habitat areas (ESHAs) under the California Environmental Quality Act (CEQA), the Santa Cruz County General Plan, and Local Coastal Programs (LCPs) mandated by CEQA. Monarch habitats are also frequently protected by local heritage tree ordinances and state-wide laws that protect riparian habitats, wetlands and watercourses.

APPENDICES
3.1 MONARCH BUTTERFLY NATURAL HISTORY

WINTERING SITE TERMINOLOGY

Monarchs roost in trees at night and during periods of inclement weather and/or low temperature. During the summer monarchs tend to roost singly, whereas during the winter they roost gregariously (socially). Masses of gregariously roosting monarchs are referred to as clusters. Trees that support clusters of gregariously roosting monarchs are called roost (or cluster) trees. Trees surrounding the roost trees that provide immediate (line-of-sight) wind protection for the roost trees are referred to as primary windbreak trees. Primary windbreak trees that stand to the south of the roost trees also create shade and diffuse sunlight.

The roost trees and their associated primary windbreak trees define the basic unit of monarch wintering habitats, the roost area. Trees that provide wind protection for the trees that compose a roost area are referred to as secondary windbreak trees. A monarch butterfly wintering habitat is thus composed of one or more roost areas and all of the secondary windbreak trees that protect them. Although monarchs utilize relatively few of the trees in a habitat as roost trees, most of the other trees play essential roles in creating a suitable microclimate—moderate temperature, high humidity, diffuse sunlight—and in providing wind protection for the clusters on the roost trees.

Although topographic (landform) features, and buildings, may also contribute to site suitability—by providing wind protection and/or shade—tree configuration is usually the most important determinant of site suitability. Some monarch wintering habitats contain only one roost area, others (if not most) provide several roost areas that are utilized sequentially during the wintering period and/or as refuges during inclement weather. Moreover, individual monarchs may utilize the same habitat in different ways; thus the same habitat may function as a temporary refuge for some monarchs, and as a part-term or full-term overwintering site for others.

Monarch wintering habitats are commonly categorized on the basis of the average duration of residence of the wintering populations. Those habitats (aka: sites) that typically support clusters of wintering monarchs for a few days to a month (or two) are grouped as Temporary Habitats; whereas those that typically host clusters of monarchs for two to six months are referred to as Overwintering Habitats.

Overwintering habitats are often subdivided on the basis of duration of residence: sites that typically support monarch populations from October into December are referred to as part-term overwintering habitats; whereas those that support monarch populations for the entire season—October through February in most years—are referred to as full-term overwintering sites. With regard to state-wide preservation of monarch populations, full-term overwintering sites are the most crucial type of wintering habitat.

In describing roost areas and temporary habitats four functional variations are generally distinguished: refuge areas, bivouac areas, autumnal roost areas, and mid-winter roost areas. Refuge areas, as the name suggests, provide temporary protection from inclement weather and/or convenient areas to roost overnight while migrating. Bivouac areas generally host populations of migrants for a few days to several weeks. Autumnal roost areas typically host monarch populations throughout the month of October (often into November), and are frequently associated with conspicuous nectar sources (such as fall-blooming composites and English ivy). Mid-winter roost areas host clusters from around mid-December through February in habitats with a series of sequentially occupied roost areas.

APPENDICES
3.2 PLANT IDENTIFICATION PHOTOGRAPHS

English Ivy

Poison Oak

Cape Ivy

Coyote Bush

French Broom

Himalayan Blackberry

APPENDICES
3.3 RECOMMENDED PLANT LIST FOR WINTERING HABITAT RESTORATION

BOTANICAL NAME	COMMON NAME	POTENTIAL ECOLOGICAL ROLE
Evergreen Trees		
Cupressus macrocarpa	Monterey cypress	Windscreen
*Eucalyptus saligna**	Sydney blue gum	Windscreen
Eucalyptus robusta	Swamp mahogany	Windscreen
*Eucalyptus microtheca**	Coolibah	Roost tree
Sequoia sempervirens	Coast redwood	Windscreen
Deciduous Trees (Lake and Creek Margins)**		
Alnus rhombifolia	California white alder	Windscreen
Alnus rubra	Red alder	Windscreen
Salix hindsiana	Hinds willow	Winter nectar source
Salix lucida	Western black willow	Winter nectar source; windscreen
Salix lasiolepis	Arroyo willow	Winter nectar source; windscreen
Mid-level and Understory Shrubs		
Arctostaphylos spp.	Manzanita	Lower windscreen
*Callistemon citrinus**	Bottlebrush	Nectar source
Ceanothus spp.	California lilac	Nectar source
*Echium fastuosum**	Pride-of-Madeira	Nectar source
*Escallonia spp.**	Escallonia	Nectar source
Heteromeles arbutifolia	Toyon	Lower windscreen
*Leptospermum laevigatum**	Australia tea tree	Nectar source
*Myoporum laetum**	Myoporum	Lower windscreen
Myrica californica	Pacific wax myrtle	Lower windscreen
Prunus ilicifolia	Holly-leaf cherry	Lower windscreen; nectar source
Prunus caroliniana	Carolina cherry	Lower windscreen; nectar source
*Rosmarinus officinalis**	Rosemary	Nectar source
Rubus ursinus	California blackberry	Nectar source
*Viburnum tinus**	Lauraltinus	Nectar source
Low-growing Shrubs, Herbs & Grasses		
Achillea millefolium	Common yarrow	Nectar source
Asclepias eriocarpa	Woollypod milkweed	Nectar source
Asclepias speciosa	Showy milkweed	Nectar source
*Carex spp.***	Sedge	Erosion control
Encelia californica	California brittlebush	Nectar source
*Festuca spp.***	Fescue (native spp.)	Erosion control
Heliotropium curassavicum	Seaside heliotrope	Nectar source
*Juncus spp.***	Rush	Erosion control
*Lantana montevidensis**	Lantana	Nectar source
Mahonia repens	Creeping mahonia	Erosion control
Monardella antonina	Monardella	Nectar source
*Salvia leucantha**	Mexican bush sage	Nectar source
Salvia mellifera	Black sage	Nectar source
Verbena spp.	Verbena	Nectar source

* Indicates non-native nectar-source plant

** Riparian restoration planting

APPENDICES
3.4 BEST MANAGEMENT PRACTICES REFERENCE GUIDE

Bay Area Storm Water Management Agencies Association (BASMAA) Start at the Source and Using Site Design Techniques to Meet Development Standards for Storm Water Quality: A Companion Document to Start at the Source www.basmaa.org

Bureau of Environmental Services, 2004. Stormwater Management Manual, Portland, OR

California Stormwater Quality Association (CASQA), 2003. California Stormwater Best Management Practices Handbook, New Development and Redevelopment, January 2003 (Updated September 2004) www.cab mphandbooks.com/

Contra Costa Clean Water Program, CA 2005. Stormwater C.3 Guidebook, March, 2005

Kennedy/Jenks Consultants, 2003. Truckee Meadows Construction Site Best Management Practices Handbook. www.TMstormwater.com

Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) http://www.scvurppp-w2k.com/Default.htm

U.S. EPA, 1983, Nationwide Urban Runoff Progra (NURP) Study

U.S. EPA, 2005. National Management Measures to Control Nonpoint Source Pollution from Urban Areas.

Washington State Department of Ecology, 2005. Stormwater Management Manual for Western Washington: Volume III -- Hydrologic Analysis and Flow Control Design/BMP's.

REFERENCES

PUBLICATIONS

Allen, James P. & Associates. October 2003. Tree Risk Management Plan for the Monarch Butterfly Habitat at Lode Street Sanitation Facility.

Alonso-Mejia, A., Arellano-Guillermo, A., Brower, L. P. 1992. Influence of temperature, surface body moisture and height above ground on survival of monarch butterflies overwintering in Mexico. Biotropica (Lawrence) 24:415-419.

Anderson, J. B., Brower, L. P. 1996. Freeze-protection of overwintering monarch butterflies in Mexico: critical role of the forest as a blanket and an umbrella. Ecological Entomology 21:107-116.

Boone/Low Architects & Planner, June 2000. East Cliff Facility Master Plan, County of Santa Cruz Sanitation Department.

Brower, L. P. 1985. New perspectives on the migration biology of the monarch butterfly, Danaus plexippus L. Contributions in Marine Science Supplement 27:748-785.

Brower, L. P., Malcolm, S. B. 1991. Animal migrations: Endangered phenomena. American Zoologist 31:265-276.

Brower, L. P. 1995. Understanding and misunderstanding the migration of the monarch butterfly (Nymphalidae) in North America: 1857-1995. Journal of the Lepidopterists' Society 49:304-385.

Calvert, W. H., Brower, L. P. 1982. The importance of forest cover for the survival of overwintering monarch butterflies (Danaus plexippus, Danaidae). J. Lepid. Soc., Cambridge, Mass. 35:216-225.

Calvert, W. H., Zuchowski, W., Brower, L. P. 1984. Monarch butterfly conservation: Interactions of cold weather, forest thinning and storms on the survival of overwintering monarch butterflies (Danaus plexippus L.) in Mexico. Atala (Portland) 9:2-6.

Clark, Donald Thomas. 1986. Santa Cruz County Place Names. Santa Cruz County Historical Society, Santa Cruz, CA.

John Gilchrist & Associates and Fall Creek Engineering. March 2005. Moran Lake Water Quality Study & Conceptual Restoration Plan.

Frey, D., Leong, K. L. H., Fredericks, D., Raskowitz, S. 1992. Clustering patterns of monarch butterflies (Lepidoptera: Danaidae) at two California central coast overwintering sites. Annals of the Entomological Society of America 85:148-153.

Hickey, John. 1968. Hydrogeological Study of the Soquel-Aptos Area, Santa Cruz, California. United States Department of the Interior Geologic Survey, Water Resources Division.

Janecki, Joni L. & Associates, Inc., Boone/Low Architects, Barrie Coate Consulting Arborists, Entomological Consulting Services LTD., John Dayton, Biologist. November 2004. Management Plan for the Monarch Butterfly Habitat at Moran Lake County Park.

Lane, J. 1984. The status of monarch butterfly overwintering sites in Alta California. Atala (Portland) 9:17-20.

Malcolm, S. B. 1987. Monarch butterfly migration in North America: Controversy and conservation. Trends in Ecology and Evolution 2:135-138.

REFERENCES

Malcolm, S. B., Zalucki, M. P., eds. 1993. Biology and Conservation of the Monarch Butterfly . Vol. 38. Los Angeles: Natural History Museum of Los Angeles County.

Nagano, C. D., Lane, J. 1985. A survey of the location of monarch butterfly (Danaus plexippus [L.]) overwintering roosts in the state of California, U. S. A.: First year 1984/85. World Wildlife Fund 106 pp.

Sakai, W. H., Calvert, W. C. 1991. Statewide Monarch Butterfly Management Plan for the State of California Department of Parks and Recreation: Final Report. California Department of Parks and Recreation, Sacramento, CA. 209 pp.+Appendices.

Santos, R. L., 1997. The Eucalyptus of California: Seeds of Good or Seeds of Evil? Alley-Cass Publications, Denair, CA. 165 pp. (also available at: http://www.library.csustan.edu/bsantos/bsantos.html)

Stern, Gary and Paul Courter, with Sally Sample. Report on EnvironmentalBaseline Study for the Moran Lake Enhancement Plan. Sate of California-Coastal Conservancy, Spring 1980.

Tuskes, P. M., Brower, L. P. 1978. Overwintering ecology of the Monarch butterfly, Danaus plexippus L., in California. Ecological Entomology 3:141-153.

Urquhart, F. A. 1960. The Monarch Butterfly. University of Toronto Press, Toronto & Lond.:. xxiv + 361 pp.

Urquhart, F.A., Beard, P., Brownlee, R. 1965. A population study of a hibernal roosting colony of the monarch butterfly (D. plexippus) in northern California. Journal of Research on the Lepidoptera 4(4) 221-226.

Urquhart, F. A., Urquhart, N. R. 1977. Overwintering areas and migratory routes of the monarch butterfly (Danaus p. plexippus, Lepidoptera: Danaidae) in North America, with special reference to the western population. Canadian Entomologist 109:1583-1589.

WEB PAGES

Monarch Butterfly Sanctuary Foundation: A Conservation Initiative to Protect Monarch Butterfly Wintering Habitat in Mexico. Learner.org. May 17, 2001. <http://www.learner.org/jnorth/sm/aboutmbsf.html>

MonarchLab University of Minnesota. June 6, 2001. <http://www.monarchlab.umn.edu/>

The Red Gum Lerp Psyllid in California. August 30, 2001. <www.cnr.berkeley.edu>