

CHAPTER E

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APPENDIX E-A Glossary of Plant and Pruning Terms

E.00 Introduction

This chapter explains the maintenance of landscape vegetation planted within the State highway right of way. Work includes irrigation, planting, plant removal and replacement, washing, pruning, fertilizing, weed and pest control, and growth retardants. Appendix E-A is glossary of plant and pruning terms and can be found at the end of this chapter.

Aesthetics, safety concerns, and functional requirements are involved in highway landscape planting. Landscaped areas should be maintained as originally designed and planted unless experience indicates otherwise. Plantings require a degree of maintenance consistent with:

- (A) The original design
- (B) Vehicle, bicycle and pedestrian safety
- (C) Use of adjoining property
- (D) Availability of funds

Highway landscape plantings are designed to serve several functions. Lineal or mass plantings can be established for aesthetic improvement and can also effectively serve as screening of traffic from adjacent properties.

A fully landscaped planted area, such as with trees, shrubs and ground cover, provides traffic screening, helps preserve property values of adjacent development, and improves aesthetic values of local communities' rights of way. Planted groundcover provides both aesthetic value and improves the stability of roadside slopes.

For charging practice instructions, see "E" Family of the Maintenance Manual Volume 2.

E.01 Policies

Maintain landscape areas as designed including maintenance of sight distances, clear recovery areas and horizontal clearances.(see Highway Design Manual Sections 902.2,902.3 and 309.1)

- (A) If changes in design are needed, they must be approved by the District Landscape Architect.
- (B) If the need for altering landscape design is required because of transients living in the landscape area, the District Landscape Architect must pre-approve the design changes, and may seek community input.

All tree pruning shall be consistent with the current ANSI A-300 standard. A copy of the standard is available from your District Landscape Specialist or Headquarters Maintenance, Office of Roadside.

- (A) Pruning low lateral branches off shrubs and trees is prohibited without prior approval by the District Landscape Specialist or District Landscape Architect. Lower limbs should not be removed or raised enough to allow weeds to grow or trash to accumulate under plants. There may be certain landscape areas where this policy may be altered to accommodate homeless and transient concerns, security, and fire issues.
- (B) Shrubs in mass plantings should not be pruned as individual plants.

Caltrans promotes water conservation as a continuing practice. Water conservation is accomplished in landscape irrigation through water management. Appropriate water management accommodates the landscape's actual water needs sufficiently to maintain healthy growing plants.

- (A) Caltrans should comply with local agencies' water conservation guidelines for watering times and use. During drought conditions, it is important to find out the local agencies' watering practices recommendations.

Plantings should be grown to achieve healthy, mature plants. Thereafter, maintenance operations should be limited to those necessary to maintain a healthy planting.

E.02 Irrigation Systems

E.02.1 Water Conservation and Management

To determine water needs, consider the following site conditions: plant species, age of plants, temperature, and wind, length of day, soil type (sand, silt or clay), slope, slope orientation, and ecotype.

Transpiration is the process by which plants pass water from their leaves to the atmosphere. The term evapo-transpiration (ET) describes the amount of water that is taken up and used by the plant through transpiration and evaporation. Reference evapo-transpiration (Eto) is measured in inches for water requirements of plants by species. Plant coefficients (Akc) are the estimated percentages of Eto that a species needs to maintain good health. For information on irrigation, refer to the Department's Roadside Vegetation Management Handbook under Irrigation Management.

Overwatering is to be avoided. Water penetration should thoroughly wet the plant root zone. Water running into gutters and drains is wasted and indicates water is being applied too fast to be absorbed into the soil or too long after the soil is saturated. On slopes, short irrigation cycles should be repeated to minimize water runoff and maximize water percolation. By minimizing irrigation runoff at all times, stormwater concerns can be alleviated.

Automatic irrigation controllers have many advantages to keeping the landscape irrigated. However, controllers are only as good as their operators, and will need to be reprogrammed seasonally. The systems should not run during rainy weather.

Automatic irrigation systems with overhead spray heads should be programmed for night watering between 8 p.m. and 6 a.m. Watering times should be adjusted, where needed, to eliminate irrigation during heavy commute hours. Overhead watering in the heat of the day should be avoided since some plantings are susceptible to leaf scorch.

Favorable public perception is important to the Department's irrigation management practices. Therefore, it is extremely important that landscape irrigation water is managed wisely. During the irrigation season, frequent inspections are important to ensure that water breaks are repaired in a timely manner. Water breaks also raise stormwater concerns.

Reclaimed water use requires the same quick repair response as potable water. In areas where riser damage frequently results in geyser-like breaks, in-line flow shutoff devices should be used. The use of pop-up sprinklers should be considered to eliminate continuing problems. Changes can be recommended by the District Landscape Architect.

For assistance on water conservation and plant water needs, contact your District Landscape Specialist.

E.02.2 Backflow Preventers

Backflow preventers shall be tested and certified annually by a person who has a certificate issued by the agency having local jurisdiction, for example: water districts, cities, etc. This testing can be done by a certified Caltrans employee or by a certified contractor who possesses a valid license.

Prior to performing any testing of devices, testers must be familiar with the regulations of local agencies, cities, and counties in their area, including any special qualification requirements that may apply, and documentation that must be completed.

E.02.3 Irrigation Controller Management

Automatic irrigation controllers are to be kept clean, rust-free, and in good working condition.

- (A) Controller cabinet bases must be free of vegetation that contributes to rusting.

- (B) Cabinet lids should have a secure lock and be maintained to eliminate intruding water.
- (C) Insect and rodent control may be necessary to eliminate wire and component damage.
- (D) Seasonal irrigation schedules should be posted inside each cabinet and copies made available at the Supervisor's office.

The District Landscape Specialist should be contacted for assistance in programming automatic controllers.

Remote Irrigation Control System (RICS) is the latest technology used in irrigation management. With RICS, the water manager can operate the entire system from a base station linked to field controllers in their area. Irrigation schedules can be altered as conditions change. Irrigation can be turned off on rainy days. The system can detect broken water mainline and shut down the system at the master control valve. The next morning, the water manager is notified of the problem and repairs can be scheduled. The central controller system increases efficiency and conserves water.

Please refer to the Department's Roadside Vegetation Management Handbook in the Irrigation Management section under Central Controllers for more information.

E.02.4 Irrigation Pumping Facilities

Irrigation pumping shall be inspected and serviced weekly during the watering season.

E.02.5 Freeze Protection

All backflow preventers, valves, and exposed plumbing shall be drained and/or covered adequately to prevent damage from freezing during the cold weather months. The material used to insulate the plumbing devices must be installed in a manner so it stays dry. (Wet insulation will freeze and will not protect the irrigation equipment).

E.02.6 Irrigating Plants

Young plants with fewer, shallower roots require more frequent watering than older, established plants.

As a rule, shallow-rooted plants, such as lawns and certain shrubs, require frequent watering for short periods of time. Deep-rooted plants, such as many trees and shrubs, require less frequent but deeper watering.

Areas watered by an automatic irrigation system should be programmed to minimize water runoff. Familiarization with the automatic irrigation system equipment is important to maximize

the benefits of the system. Special attention should be given to watering areas under highway structures, which do not get naturally watered by seasonal rainfall.

Generally, drought tolerant native trees and shrubs require less water once they become established. Rainfall is all that some native plants require after the first few years of establishment. During the establishment period, native plants should be watered only as often as recommended.

Weak wood, excessive top growth, and/or destructive fungi may result from over-watering. Weak, succulent growth on plants also cannot withstand winter frosts.

E.03 Plantings

E.03.1 Tree Inspection

Conduct visual surveillance, to extent reasonable, to detect trees and limbs which may be a hazard to traffic, pedestrians, highway appurtenances, electric utility lines, and adjacent property.

Conditions such as loss of root support, interior-rotting, and split limbs can be hard to detect.

E.03.2 Vegetation Control

Weeds and grasses must be controlled to the extent that they do not become damaging or present a fire hazard to ornamental plantings.

Control of vegetation along fence lines is necessary to protect the State's investment and also provide a neat finish to other roadside vegetation.

Plantings of trees and shrubs that are, or will become, too close to the edge of pavement or right of way fence should be controlled.

Trees should never be planted in the clear recovery area. (see Highway Design Manual Sections 902.2,902.3 and 309.1)Such plantings should be selectively thinned or removed entirely, especially if the remaining plants will spread and replace the original foliage that is removed. Consult with your District Landscape Specialist and District Landscape Architect before removing trees or shrubs.

Groundcover should be controlled to prevent undesirable spreading into drainage facilities, pathways, sidewalks, bicycle trails, shoulders, plant basins, fences, tree wells, ornamental plantings, and other areas where groundcover is not desirable.

E.03.3 Plant Removal/Replacement

Overcrowding of plants can occur as plantings mature. This condition requires a thorough study before thinning and should be accomplished jointly between the Landscape Specialist and the District Landscape Architect.

- (A) The removal of front row shrubs next to the roadway allows the second row to develop naturally. This is preferable to saving both rows at the cost of frequent and unsightly pruning of the original first row. Similarly, fence line row of shrubs can also be overcrowded.
- (B) Dead ornamental trees and shrubs within the right-of-way should be removed, including chipping, hauling the brush, and removing or grinding the stump.
- (C) To reduce slippery conditions on pavements, trees or shrubs located in areas subject to snow and icing conditions should be removed, where feasible, to expose pavement to wind and sun.
- (D) Plants destroyed in vehicular crashes should be replaced in like size and kind. Replacements should not be made if adjacent plant growth will fill open spaces left by missing plants within a reasonable time.
- (E) Specific sites with homeless and security concerns may warrant the need for plant removal.

All seedlings and established trees shall be removed from the clear recovery zone. (see Highway Design Manual Sections 902.2, 902.3 and 309.1)

The District Landscape Architect and District Landscape Specialist shall approve all design changes.

E.03.4 Inspection of Nursery Stock

Upon receipt of any nursery stock, check the shipping permit. Plants shipped within a county that has a certificate of inspection and release, an exemption tag, or plants that have an inter-county nursery stock certificate do not have to be held for inspection.

Notify the County Agricultural Commissioner and have the plants inspected before planting if they do not have proper tagging. Check nursery stock closely for quality and adherence to nursery standards before acceptance. All plants shall be healthy, shapely, and well-rooted. Roots shall show no evidence of having been restricted or deformed at any time. The stems or trunks of trees shall show no signs of having been cut, broken, mutilated, scraped, girdled, or restricted by plant ties or supports.

Plants shall conform to nursery standards, be free from insects, pests, and diseases and shall be grown in nurseries inspected by the State Department of Food and Agriculture.

Inspect plants either prior to or upon delivery. If it is determined by Caltrans Landscape personnel that any plant is rootbound or is in any way not acceptable, that particular plant shall be rejected, and must be replaced with an acceptable.

E.03.5 Planting Containerized Stock

Containerized nursery stock requires daily watering during hot, dry, or windy weather.

Planting holes for trees or shrubs from canned or balled stock should be at least twice the diameter and 6 inches deeper than the plants rootball. These holes are to be back-filled with native soil or topsoil.

Place the rootball in the hole at a depth equal to its original container height. The hole must be back-filled and watered immediately. Compost may be evenly mixed with backfilled soil around containerized stock and used on the surface as mulch.

It is good practice to not remove containers until the time for planting. Early container removal often allows roots to dry on the outside of the ball, resulting in plant injury.

Roots encircling the rootball should be cut and evenly spread out in the planting hole. Do not destroy the rootball, either in root handling or during planting operations.

When transplanting trees or planting trees from 15-gallon container size or larger, consider the use of vitamin and/or hormone-type materials and anti-transparent materials to prevent shock.

E.03.6 Planting Bareroot Stock

Some deciduous plants can be transplanted bareroot during their dormant period. This period is during the winter when the plant is without foliage and translocation of plant foods is at a minimum due to cooler temperatures. Bareroot stock must be kept cool, and the roots must be kept moist during the period of removal from the nursery row to final planting. This is commonly done by "heeling-in" the roots in moist sand or wood shavings in a protected location.

Planting holes should be large enough to accept the roots without doubling or bending. The soil should be loosened well below the root area. Topsoil or native soil is placed on the bottom of the hole prior to planting.

Damaged roots should be cleanly removed.

When planting the bareroot plant, the roots should be spread naturally and back-filled with topsoil and/or native soil, keeping the crown of the plant as high as it was originally. Do not tamp the soil around the roots. It should be washed in with water and the soil gently poked to

eliminate air pockets and to settle the soil. Mulch may be placed on the surface, but not mixed into the planting hole.

Stakes, if used, should be placed after the tree roots are located in the hole and prior to back-filling to avoid root damage.

E.03.7 Tree Stakes and Ties

It is best to buy trees that will not require stakes and ties.

Tree ties should be checked and loosened as the tree trunk expands, or replaced as old ties break or wear out. A material such as tree tape, plastic, or rubber belting makes a desirable tie when looped around the tree in a figure eight, and fastened to the stake securely. Enough room should be left for the trees to move and grow.

Ties should be placed as low as possible on the tree to provide support, yet allow the main trunk to flex naturally. When the tree no longer requires support, the stakes and ties should be removed.

E.03.8 Mulching Plants

Conservation of soil moisture and weed prevention in planted areas may be accomplished by the proper use of mulch materials. Wood chips, green waste, shredded bark, compost, and/or sheets of landscape fabric may be used to cover the ground around and between plants.

Wood chips and shredded bark are often available from district tree crews or from local cities, municipalities, utility companies, recyclers, lumber mills, and arborists. Only accept and use clean mulches. Do not use mulches with trash, plastics, heavy metals, poisonous shredded plants, construction wastes, or obvious undesirable plant seeds. Leafy material in mulches should be kept to a minimum, since leaves harbor more diseases than bark does. Prevent mulch from burying plant trunks. Mulch touching tree trunks can cause crown rot and kill the plant. Keep mulch a minimum of six (6) inches away from all trunks.

E.04 Tree and Shrub Maintenance

E.04.1 Caring for Young Trees

Tree care during the first few years can have a noticeable effect on their economical establishment and usefulness. The most appropriate means of growing a young tree to a useful size is with minimum pruning. Prune out only branches that cross. Do not top. Shape only when necessary.

E.04.2 Irrigating Young Trees

Trees are generally planted by contract along Caltrans roadsides in amended soil with slow release fertilizers before being accepted by Caltrans. Regular watering may be required depending upon the plant species, local growing conditions, slope aspect, and climate. Some species in some locations may always require watering during the dry season. Watering should be gradually tapered off as trees mature. Do not over-water native or drought-tolerant trees.

E.04.3 Fertilizing Young Trees

There is a wide selection of types of fertilizers for a variety of specific uses, along with differing formulas.

Every fertilizer's label shows, in numbers, the formula of major nutrients (N-P-K). N-P-K stands for the formula of nitrogen (N), phosphorus (P), and potassium (K). Macro- and micro-nutrients may also be included.

Fertilizers are available in dry or liquid form. There are further differences between complete, simple, special-purpose and organic fertilizers. In addition, there are differences between controlled release, tablet, and combination products.

Due to California's many ecotypes, elevations, climates, and soils, each planting area dictates its own fertilization needs. Typically, native plants thrive without fertilization. However, ornamental plantings typically require some fertilization on a continuous basis to ensure health and vigor.

Consult with your District Landscape Specialist and District Landscape Architect if a loss of plant health and vigor is present.

E.04.4 Fertilizing Young Shrubs and Groundcovers

Newly planted shrubs and groundcovers should be fertilized only after new growth indicates the plant is established and capable of using fertilizer. The lack of vigorous growth and deep green coloring in the foliage of a plant is one indication of the need for fertilizing and is prevalent in locations with poor soil fertility. Poor drainage, insufficient water, root diseases, and/or hot weather may result in similar symptoms.

Nitrogen is the element that is most needed in California soils and should be replaced frequently due to its instability.

E.05 Controlling Pests and Disease

E.05.1 Eucalyptus Longhorn Borer

The adult Eucalyptus Longhorn Borer is a 1-inch long, dark blackish-brown beetle with cream-colored zigzag-shape on its back.

The larvae grow to 1½ inches long and feed on the under-bark of the eucalyptus tree. Eucalyptus Longhorn Borers do extensive damage to the tree and may kill it by girdling the trunk.

The adult emerges in late April throughout the spring and summer months. The insects prefer to lay their eggs in trees that are stressed and weak. They also prefer areas of fresh cut limbs and logs.

Things to do to stop the spread of this insect:

- (A) Eucalyptus trees should be kept healthy by periodic irrigation during drought conditions.
- (B) Trees should be pruned and trimmed during the winter and early spring months when adults are not active and nighttime temperatures are at or below 50° F.
- (C) Infested wood should be buried, chipped, or solarized (wrapped in plastic for a minimum of six months).
- (D) Infested trees should be removed. Wood and trimmings should be disposed of by burning (where legal to do so), burying, chipping, or solarization (wrapping in clear plastic for six months).
- (E) Eucalyptus wood or trimmings must not be moved out of the area.
- (F) If the beetle or its larvae is seen, contact your local County Agricultural Commissioner, the California Department of Forestry, or the California Department of Food and Agriculture.

E.05.2 Pine Pitch Canker

Pine Pitch Canker is a fungal disease of pines. Monterey pines and Bishop pines are especially susceptible, although other non-native and native California pines can also become infected. It exists in 14 coastal and adjacent inland counties from San Diego to Mendocino.

The disease is spread by insects that have become contaminated by the fungus. Pine Pitch Canker can also be spread by transporting infected trees and tree parts and using contaminated tools.

Infected seeds and seedlings may initially appear disease-free, but may later develop disease symptoms.

It is important to be aware and follow local agency, California Department of Forestry, and Food and Agriculture Department's recommendations for cutting, transporting, and handling infected trees/parts. Things that can be done to prevent spreading this disease are:

- (A) Know if you are in an infested area. Be able to recognize the disease.
- (B) Realize the disease can be spread by transporting tools, any tree parts or waste and seeds/seedlings. Always follow recommendations provided by your local County Agricultural Commissioner for proper tool treatment. Clean and sanitize tools before going into a non-infested area.
- (C) Contaminated materials should not be transported into a disease-free area.
- (D) Infected material/trees should be removed and destroyed by burying, tarping, burning, or chipping. Tarping must be for six (6) months under clear plastic.
- (E) Plant material should be covered when taken offsite.

E.05.3 Red Imported Fire Ants

Imported red fire ants are aggressive, reddish brown to black ants that are 1/8 to 1/4 inch long. They construct nests that are often visible as dome-shaped mounds of soil, sometimes as large as 3 feet across and 1-1/2 feet in height. In sandy soils, mounds are flatter and less visible. Fire ants usually build mounds in sunny, open areas such as lawns, pastures, cultivated fields, and meadows, but they are not restricted to these areas. Mounds or nests may be located in rotting logs, around trees and stumps, under pavement and buildings, in electrical cabinets, and occasionally indoors. When fire ants nests are disturbed, numerous fire ants will quickly run out of the mound and viciously attack any intruder. These ants are notorious for their painful, burning stings that result in a pustule and intense itching, which may persist for 10 days. Infections may occur if pustules are broken. Some people have allergic reactions to fire ant stings that range from rashes and swelling to paralysis or anaphylactic shock. In rare instances, severe allergic reactions cause death.

Fire ants may infest irrigation controllers and electric valve boxes. They are usually smaller than local ants. Fire ant infestations are typically found in the southern half of the state, but will probably spread to the rest of the California.

Contact your local County Agricultural Commissioner if you suspect fire ants in any location.

E.05.4 Oleander Leaf Scorch

Oleander Leaf Scorch (OLS) is a relatively new disease that was first discovered in the 1990's in Riverside County. Although primarily a southern California disease, OLS is spreading rapidly and is a serious concern to those in agriculture and government.

OLS is caused by the bacterium *Xylella fastidiosa*, which is the same species (although a different strain) that causes Pierce's Disease, Almond Leaf Scorch, and Phony Peach Disease. OLS strains of *Xylella fastidiosa* infect periwinkles and oleanders. The blue-green sharpshooter and the glassy-winged sharpshooter vector the OLS bacterium. Oleanders affected by the disease decline and then die, usually within three to five years of the first symptoms. There is no known cure, either with chemicals or cultural methods.

OLS is readily (and quickly) transmitted by the sharpshooter (an insect). OLS symptoms begin with yellow margins or spots on the oleander leaves before the edges and tips take on a scorched appearance. Then twigs and branches die-back. The bacteria clog the xylem (water-conducting tissue) of the oleanders, cutting off water supply to the leaves. Symptoms of oleander leaf scorch may be confused with symptoms of water stress, chemical damage, or plant burn.

When a sharpshooter feeds on a plant that is infected with *Xylella fastidiosa*, it acquires the bacteria, which then multiplies within the insect's mouthparts. The sharpshooter then transfers the bacteria to another plant when it feeds. In addition, high temperatures will more quickly stress and kill infected plants. Current research indicates the 'Ruby Lace' variety of oleander does not seem to die as quickly as the 'Hardy Pink' and the 'Hardy Red' oleander varieties.

Pruning out the part of the oleander plant showing symptoms may help the appearance (aesthetics) of the oleander, but pruning will not save the plant. The bacteria have already moved throughout the plant, and the limbs that show symptoms are only the first to be affected. However, pruned plants may be able to survive longer than those left un-pruned. Always sanitize your pruning tools by dipping in a 10% bleach solution.

Glassy-winged sharpshooters' low flying pattern may help oleanders in medians. Sharpshooters have a natural tendency to fly between 3-16 feet above the ground.

E.05.5 Sudden Oak Death

The tree disease known as Sudden Oak Death (SOD) is caused by a mold-like microscopic pathogen called *Phytophthora ramorum*. The pathogen infects several species of native oaks in California, creating cankers under the bark of the trunk. Beetles and decay fungi often further colonize infected trees, which may lead to a rapid weakening of the tree and eventual death. SOD also infects a number of other species in California's woodlands though the symptoms on these species are milder, usually only leaf spots and twig die back, and typically not fatal. How SOD is spread is not yet totally known. Research (during 2001-2005) has shown that *Phytophthora ramorum* can be spread from plant to plant via wind-driven rain, the movement of

soil and water, and by moving infected plant parts, especially infected leaves of foliar plant hosts.

Researchers are also studying if *Phytophthora ramorum* can be spread in the air or if some animals may help disperse spores. For the disease to be spread, the transported *Phytophthora ramorum* must successfully infect an uninfected host plant.

Things to do to stop the spread of SOD:

- (A) Know if you are in an infested area.
- (B) Be able to recognize the disease.
- (C) SOD can be spread by transporting tools, any tree parts, wastes, and firewood.
- (D) Treat pruning tools before using them to trim non-diseased plants. Contact the local County Agricultural Commissioner for the latest treatment procedures.
- (E) Leave as much plant material as possible onsite, especially leaves and branches less than 4" in diameter. This material can be chipped and left as mulch.
- (F) Transport material that must be removed to an approved SOD collection or disposal site within the same county. Check with your local County Agricultural Commissioner for approved locations.
- (G) Obtain the needed Compliance Agreement from the County Agricultural Commissioner before moving SOD material outside of regulated areas.

E.05.6 Eucalyptus Red Gum Lerp Psyllid

In June 1998, eucalyptus trees along the freeway in El Monte, in Los Angeles County, were found heavily infested with an unknown insect. Samples were taken and the insect was identified as the lerp psyllid (*Glycaspis brimblecombei*). In less than a year, the lerp psyllid's presence was reported in many other California counties. The lerp psyllid (an Australian insect) severely defoliates some species of eucalyptus trees, and over time, the tree dies.

The lerp psyllid attacks eucalyptus leaves. The wingless, yellowish immature form (nymph) secretes a waxy protective conical cover, called a lerp. The nymph sucks the juices from the leaf, which kills the leaf and the leaf falls off. The insect has since moved to another nearby leaf to grow and lay eggs on more leaves. The nymphs also secrete large amounts of sticky honeydew on the eucalyptus leaves. This results in blackened foliage due to the growth of sooty mold. Lerp psyllids prefer new growth, but can be found on all foliage parts. High lerp psyllid populations on eucalyptus species normally result in withering and dropping of the leaves.

Through the tree's stored energy, it puts out new growth (leaves) and the insects begin to feed on them. The eucalyptus tree can only put out new growth a few times, until all of its reserved energy is used up. Eventually, repeated dieback causes the death of weakened trees.

The lerp psyllid infects over two dozen eucalyptus species. There are three eucalyptus species easily infected and heavily used on California roadways. These species include the Red River Gum (*Eucalyptus camaldulensis*), Red Ironbark (*Eucalyptus sideroxylon*) and White Ironbark (*Eucalyptus leucoxylon*). The species of eucalyptus is the primary determinant of whether lerp psyllids will be abundant. Cultural practices and overall tree health may also influence lerp psyllid populations.

Psyllid-specific parasites were introduced in 2003 in an effort to provide biological control as a long-term solution. At least one psyllid-specific parasitic wasp (*Psyllaephagus bliteus*) has been introduced from Australia. The tiny female wasp lays its eggs inside the lerp psyllid nymphs.

Because of the lerp psyllid's exponential population growth and ability to fly, this little insect has literally spread throughout California in less than seven (7) years. Many groves of eucalyptus are diseased and dying along Caltrans roadways. Entomologists are optimistic that the parasitic wasps will spread throughout the state and stop the widespread devastation.

E.06 Groundcover Maintenance

E.06.1 Caring for Groundcovers

Older landscaped areas tend to utilize iceplant and/or ivy extensively over large areas. Newer landscaped areas tend to have smaller groundcover planting areas with a much wider variety of groundcover species. (Groundcover species currently planted include myoporum, lantana, trailing manzanita, prostrate coyote brush, trailing rosemary, creeping St. Johnswort, trailing African daisy, trailing acacia, groundcover roses, gazania, star jasmine, vinca, cape honeysuckle, plumbago, bougainvillea and honeysuckle). Although many groundcovers are relatively hardy, they still require periodic care.

Every groundcover species has different needs and requirements, so maintenance should be tailored specifically to the plant species. Maintenance includes watering, fertilizing, weeding, mulching (until the groundcover fills in), trimming, and edging. Occasionally, insect and rodent control may be necessary. If you are unclear about specific groundcover care, consult with your District Landscape Specialist.

E.06.2 Edging Groundcovers

Groundcovers must be edged to preserve highway safety when encroaching into the traveled way. Groundcovers should also be edged when necessary around highway facilities (such as drain ditches and fences). Chemical treatments should be considered since they are more

economical (providing the correct type of material is chosen and the application is timed correctly).

Growth retardants may be used to retard the growth rate of groundcovers, thus reducing the need for manual trimming and/or chemical edging.

Do not use systemic or translocating types of herbicides.

A contact material, which kills only the parts sprayed, may be chosen. It should also be one that does not stain curbs, gutters, fences, or the sprayed groundcover. Spraying is a faster operation than cutting and removal; however, spraying must be done as frequently as is necessary to prevent excessive encroachment into traffic, since the dead tips will be left in place. A hydraulic, cab-operated spray bar is available for edging groundcovers. Always follow your District Landscape Specialist's recommendation.

E.06.3 Controlling Weeds in Groundcovers

Caltrans implements Integrated Vegetation Management (IVM) methods for weed control in groundcover plantings. Successful IVM strategies for groundcover weed control include manual, cultural and chemical.

Manual weed control techniques for weed control in groundcover plantings include hand pulling, hoeing, and using hand-held power equipment (such as string trimmers and walk-behind mowers). Manual weed control may be the best method for removing thick, weed-choked areas in established groundcover plantings. Typically, manual weed control is the most labor intensive IVM method.

Cultural weed control techniques for groundcover areas include mulching, proper watering/irrigation, correct fertilization, successful pruning and shaping, and other proper horticultural practices. A 4 to 6-inch layer of weed-and-trash free organic mulch can be effective at controlling weeds. Mulches also help with breaking down the force of water droplets, insulating the soil from harsh effects of heat and winds. Mulch decomposes within a few years and should periodically be reapplied. Placing landscape fabric (which allows air and water to pass through) on the soil, prior to applying mulch, also helps prevent weeds. Ensure that mulches remain onsite, as they may travel into roadways, drainage pathways and water courses.

Proper horticultural practices help groundcovers remain healthy and vigorous. Healthy ornamental groundcover areas can crowd out nearby weed species. Chemical weed control in groundcover areas is the application of herbicides. Chemical applications must be properly timed, using the correct rate, adhering to proper spray techniques and using the best selective herbicide for the groundcover and weed species at the site. Chemical applications can be the most effective IVM methods for controlling weeds in groundcover plantings.

In many locations, chemical applications are the most economical IVM method. Please refer to the Herbicide List in Chapter “C”, Vegetation Control.

Before using chemical IVM methods, a recommendation is required by your District Landscape Specialist. Always wear your Personal Protective Equipment (PPE).

Combining several IVM methods can provide an effective, long-term weed control strategy for existing mature groundcover areas. A typical combination of IVM methods may include manually removing existing weeds in an established groundcover planting. After new weeds sprout (germinate), apply a post-emergence chemical application to kill the new weeds. Lay down some landscape fabric and apply a 4 to 6-inch layer of organic mulch. Proper horticultural techniques will allow the groundcover to grow vigorously. The area should fill in with groundcover, and the planting will have fewer weeds. Consult with your District Landscape Specialist to ensure the best combination of integrated vegetation methods are being used, in the correct order, to enhance your specific site.

See Herbicide List, Chapter “C”, Vegetation Control.

E.07 Lawn Maintenance

E.07.1 Caring for Lawns

Lawn care on highway projects should be consistent with the purpose of the original planting. An area restricted to high-speed automobile traffic may be maintained at a lesser standard than an area with pedestrian traffic.

In areas observed by pedestrians or slow traffic, walks and curbs should be edged frequently. Weeds should be eliminated from cracks, and gutters should be cleaned.

E.07.2 Mowing Lawns

Lawns should be mowed to a height determined by the variety of grasses and intended purpose.

Since consistent appearance with a minimum amount of care is the requirement of a highway lawn area, the height of mowing is of prime importance. Taller lawn blades are preferred. A taller turf height allows ample food producing surface to support a healthy root system. It also protects the soil surface from exposure to the hot sun, and tends to prevent weed growth in the turf. Lawns are dependent upon their foliage for the manufacture of their food.

A closely clipped lawn will maintain its health and beauty only if artificially fed calculated quantities of fertilizer. Without extra feeding, the root system will be shallow and incapable of obtaining water and minerals from a maximum amount of soil. Shallow roots are conducive to rapid fluctuations in grass health and irrigation mishaps. A long hot weekend without water may cause the lawn to die if the root system is shallow.

Excessive use of fertilizer and water will result in the need for more frequent mowing, without benefit to the lawn. Lawn clippings may be left on the lawn unless excessively heavy.

E.07.3 Mowing Equipment for Lawns

Power lawn mowers, prior to use, should be completely:

- (A) Lubricated
- (B) Adjusted
- (C) Checked for loose nuts and bolts

Oil level and gasoline supply should also be checked. Cooling systems should be checked twice daily for grass, which may be packed between the cooling fans and a cover.

The oil bath in air filters should be kept clean and free from grit, which could be sucked into the motor.

Height of cut may be adjusted by running the mower onto a level surface, placing a board under each reel as it is adjusted. Reels should never be tightened enough to cause any resistance against the bed knife.

E.07.4 Irrigating Lawns

Water requirements of a lawn depend upon the season, climate, and soil, varieties of grasses, drainage, slope, slope aspect, and winds.

A deep-rooted system is developed by deep watering and helps lawns survive during periods of unusual climatic conditions.

Sprinklers should be allowed to run until the water has penetrated the soil well below the root zone. It may be necessary, due to quick run-off on a steep, dry slope or compacted soil, to start penetration by short and frequent watering until the soil is capable of taking a full watering. This method, however, should not be made a steady practice, as deep and less frequent watering is more beneficial.

E.07.5 Fertilizing Lawns

Chemical fertilizers are formulated for specific purposes, with the analysis required by law to be printed on the bag or container. An 11-8-4 (N-P-K) fertilizer would have an analysis of 11 percent nitrogen (N), 8 percent phosphorus (P) and 4 percent potassium (K). Of 100 pounds of an 11-8-4 formulation, eleven pounds would be actual nitrogen.

For best results under most highway conditions, a mixed lawn should receive one (1) pound of actual nitrogen per 1,000 square feet for each growing month. Correct amounts of fertilizers reduce the chance of "fertilizer burn", and maintain a constant rate of lawn growth rather than cycles of growth.

Lawns should never be fertilized while the grass is wet. Sufficient water should be applied after the fertilizer application to dissolve the fertilizer deeply into the root zone. This first watering must be thorough.

Fertilizers should be applied evenly with seeder-type spreaders or wheel-mounted fertilizer spreaders. Care should be taken with either type of spreader to place the fertilized strips to completely cover the area. Do not fill spreaders on the lawn as fertilizer is frequently spilled, killing the lawn in that area. Wheel-mounted spreaders will deposit excessive amounts of fertilizer on turns or while standing, unless the supply is shut off from the hopper.

E.07.6 Controlling Weeds in Lawns

Weeds in lawns can be controlled largely by proper turf management. A thick vigorous lawn leaves little room for weeds to grow. If the correct mixture has been planted for any given area, proper fertilizing, watering, mowing and drainage will control and prevent most weeds. Annual weeds may be controlled early in the growing season by fertilizing the lawn, raising the reels on the lawn mower until the crowns of the weeds have grown high enough to cut off, then lowering the reels and mowing.

Broadleaf perennial weeds (such as plantain and dandelion) often crowd into lawns on poor soil. Herbicide application may be used for broadleaf weed control. Equipment used for the application of broadleaf herbicides should be thoroughly washed inside and out with a neutralizer before being used for any spray materials, which will be applied to desirable plants. The neutralizing solution should remain in the tank overnight or longer. Contact the Landscape Specialist for a pesticide recommendation.

E.07.7 Controlling Crabgrass in Lawns

The key to a successful chemical crabgrass control program is knowing when crabgrass seeds germinate in a specific area and applying pre-emergent chemicals before they sprout.

Pre-emergent herbicides give the best control by killing plants prior to germination rather than allowing invasions to weaken the lawn from competition.

If crabgrass plants have developed, seed heads can be prevented from maturing by mowing and chemically treating with a registered post-emergent material.

The District Landscape Specialist must provide the pesticide recommendation.

E.07.8 Lawn Soils

Most lawns prefer a well-drained friable soil mixture of loam, sand, and humus content with a neutral (pH 7). Air is a vital necessity in the soil to encourage bacterial action on fertilizers decaying humus for the roots, and to aid movement of soil water.

E.07.9 Renovating Lawns

After years of mowing, a thick layer of thatch and humus can build up. This is especially true of Bermuda grass and crabgrass. Traffic will also deposit fine particles of soil and sand and trash on lawns adjacent to the traveled way to a depth well above the original lawn level. Renovation is necessary to correct these conditions.

Renovating should not be done on turf that has not built up thatch or silt, and should not be planned as a part of regular annual turf maintenance.

Once turf has been reduced to the desired level by renovation, this level may be maintained by the periodic use of a vertical-cut type mower. Without damage to the turf or unsightliness, this type of machine eliminates the horizontal runners of Bermuda and crabgrass, and lifts up the impermeable thatch.

Renovating should be done just prior to the growing season. This prevents a long unsightly recovery period, and reduces the possibility of a crop of weeds growing before the lawn becomes reestablished.

In areas of poor soil, a top dressing of weed and seed-free compost may be necessary to replace the humus which has been removed. Reseeding will be required in areas where the turf has been completely removed, but should not be considered in areas of Bermuda grass.

E.07.10 Repairing Lawns

In areas requiring repair or replacement of lawn, replant with the same sod, stolons, or seed mixture as used in the original planting.

In situations where the original planting has failed to thrive, the District Landscape Architect and District Landscape Specialist should be contacted for assistance in selecting a more suitable turf species. One (1) pound of most lawn seed mixtures is required for each 200 square feet of area.

If toxic materials have been spilled on established lawn areas, it is important to remove the soil to a depth including all the toxic material, replace with topsoil and replant or cover with established sod. For a conspicuous area, repair may be made with sod from a less conspicuous area, or sod from the border around maturing shrub beds.

E.07.11 Repairing Lawns with Sod

In preparing an area to replace with sod, the existing lawn should be removed and the surface should be lightly cultivated after it has been firmed and leveled. Small or sunken areas should be repaired and re-leveled prior to sod installation. After laying new sod firmly onto the existing soil, the sod should be tamped or rolled with a weight to make contact with the soil, top dressed to fill cracks, and irrigated thoroughly.

E.08 Lawn Diseases

Lawn diseases are caused by fungi, bacteria, viruses, and nematodes.

In addition to the organic plant diseases, there are physiological diseases caused by unfavorable growing conditions, such as waterlogging, compaction, and chemical and fertilizer injury. Generally, serious disease injury is less likely to occur with vigorously growing grasses. Heavy organic content (thatch) on the surface is conducive to fungi.

E.08.1 Controlling Sod Webworm in Lawn

The Sod Webworm is probably the most troublesome insect in our lawns. Webworms hatch first in April and May, laying the eggs for another brood which hatches in August and September. The larva or web worms feed at night on the grass just above the ground and not on the roots.

For this reason, spray materials should be applied on a previously well-watered lawn area. Water should be withheld as long as possible after the spray application to retain the spray on the foliage. The District Landscape Specialist must be contacted for a Pesticide Recommendation. No treatment is required after cool weather starts since worm activity ceases. New lawns should normally be sprayed in May and June if Sod Webworms are present.

E.08.2 Controlling Mites in Lawns

Mites can be a serious problem on hybrid Bermuda grass in safety roadside rest areas.

Damage is evident as a wilted appearance due to mites sucking plant juice from the above-ground growth. Lawns are weakened and may die if not treated. Where damage is severe, the sparse areas will allow invasions of undesirable weeds to compete with the weakened Bermuda grass. The District Landscape Specialist should be contacted for a Pesticide Recommendation.

E.08.3 Controlling Lawn Moth in Lawns

Lawns sometimes get a lawn moth infestation. A heavy infestation of lawn moths may seriously degrade lawns. If you have an infestation, contact your District Landscape Specialist for an Insecticide Recommendation.

Lawn should be mowed and watered thoroughly, immediately prior to applying the insecticide. Do not water after application until necessary. The lawn should be left unmowed as long as practical after spraying.

E.08.4 Controlling Brown Patch in Lawns

Brown Patch is caused by a fungus which develops during periods of high temperature and humidity. It appears as regularly shaped, browned area from a few inches to 3 feet or more in diameter. This condition is recognized by the dead grass attached to its roots, in contrast to the loose dead grass on an area killed by the sod Webworm. Brown Patch usually prefers bluegrass, rye grass, and bent grass lawns.

Good turf management is the best IVM method cultural to prevent Brown Patch from occurring.

Infected areas should be mowed 2 inches high, watered deeply, not more often than twice a week, and not over-fertilized.

If Brown Patch exists, repeated applications of fungicides may be necessary. Contact your District Landscape Specialist for a Fungicide Recommendation.

E.09 Washing Plantings

In the event landscape plantings along freeways become unhealthy due to deposits of road dust and exhaust residues on the foliage, plant health may be restored and maintained by periodic washing.

Clean water is sufficient; however a small amount of wetting agent or plant soap in the water may be required under extreme circumstances to loosen the encrustation. Minimize and control runoff into drainage pathways and waterways.

E.10 Pruning

Pruning preserves the health and structure of trees and shrubs, prevents damage to adjacent property, and provides safety for vehicle, bicycle, and pedestrian traffic.

Tree pruning practices will follow the current ANSI A-300 standards.

Trees or shrubs should be trimmed to ensure visibility of highway signs and safety devices. Pruning should also provide a 17 foot clearance above the traveled way and shoulder.

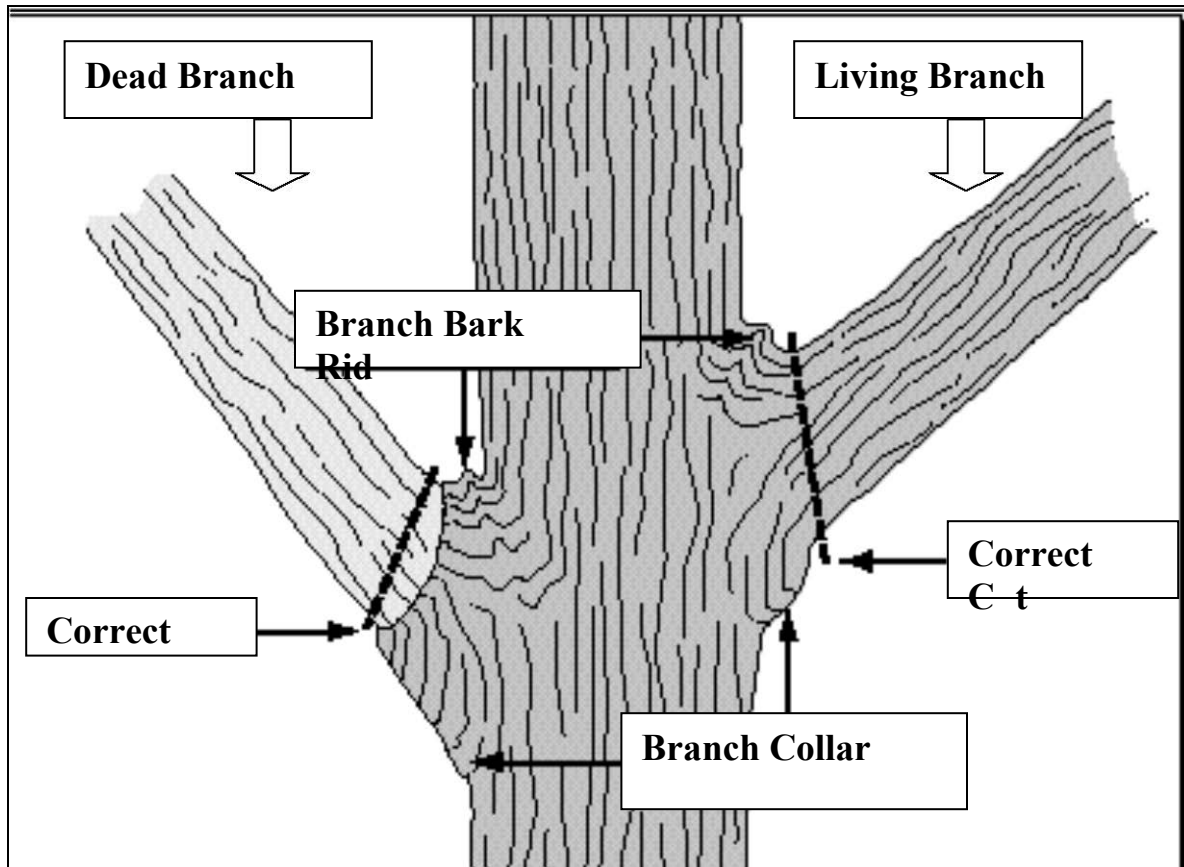


Figure E-1: Pruning

Target tree cuts just outside the branch collar and branch bark ridge. This is the area where trees can isolate wounds and heal quickly. Cuts farther away from the target area encourage rot and disease in trees.

E.10.1 Pruning Trees

Newly planted trees should not be pruned except to remove broken or damaged limbs. After the tree has begun to establish its root system and new growth becomes visible, light pruning for shape can begin. Proper pruning of young established trees can save the tree from severe pruning and many hours of the tree crews' time when the tree matures. Lower limbs should not be removed.

New growth can be encouraged in older plants by periodically removing large, old inner wood to open up the interior of a plant. Some plant species, such as Acacias, when used as a group or screen planting, may need topping while young to force lateral (side) spreading.

Plants that tend to be leggy or have excessive top growth may be topped by cutting the taller shoots back to lower outside lateral shoots or branches.

All young trees should be left with a form characteristic of their species following pruning.

E10.2 Pruning Deciduous Ornamental Trees

Pruning deciduous ornamental trees is different than pruning massed shrubs (either in a lineal pattern or in a large mass-grouped area). Individual deciduous tree pruning should be confined to the removal of suckers and crossing branches. Low limbs should be encouraged, not removed. Lateral limbs must be shortened or removed if they interfere with traffic and other safety issues. The terminal of the leader can be cut back to an upright lateral only if a serious bend has occurred due to a prevailing wind.

A strong, straight leader should not be cut back in order to force low lateral growth. Such a tree will assume its own characteristic proportions if untouched; therefore, pruning is best confined to corrective cuts necessitated by wind, suckers, or breakage. The majority of pruning, and especially heavy trimming, on deciduous trees should only be done during dormancy.

E10.3 Pruning Evergreen Ornamental Trees

Evergreens are never completely dormant. They often have several flushes of growth each year. They may be pruned anytime, except when flowers or fruit are desired. Such trees should be pruned, if required, after their showy period.

As with deciduous ornamental trees, pruning on evergreen ornamentals should be minimal, only to remove crossing branches. Lower branches of young pyramidal evergreen trees should not be removed.

E10.4 Pruning Shrubs

Pruning reduces the size of a shrub without altering its natural appearance. Pruning removes dead and diseased limbs, crossing limbs, and reduces the size of overgrown shrubs. Pruning also promotes or directs new growth, blossoms, fruit, and/or berries.

The best practice is to prune most shrubs and trees during the winter season, while plants are dormant. Where lateral (side) branching in mass-planted shrubs is desired, tops of apical (top) branches of young plants should be pruned back to a suitable level to encourage lateral (side) branching.

E10.5 Pruning in the Median

Prune if growth encroaches onto the shoulder. Oleanders within a median or screen planting should not be regarded as individual plants. Any pruning should treat them as a unit or mass.

Low branching and ground coverage should be encouraged. Low growth should not be removed. These same methods should be applied to other shrubs also used for median or screen plantings.

E10.6 Pruning Tools

Proper tool usage and correct pruning techniques are very important. Caltrans uses a wide variety of pruning tools including chainsaws, pole loppers, saws, bow saws, ratcheting (forestry) loppers, hand shears, and loppers. Always select the best tool for the plant being pruned.

Hedge shears should not be used to prune shrubs except for retaining hedges and shrubs designed to be maintained in a formal manner. Hedge-shear type of clipping results in a hedge or shrub having such dense growth on the perimeter that the inside of the plant is bare of foliage from the lack of light.

In general, the use of tractor-mounted mower heads should not be used to trim shrubs (oleanders, etc.), as they do not make smooth cuts and they tend to tear. Orchard cutter heads that make smooth cuts are acceptable in some situations. Tractor-mounted mowers should not be used to prune trees or large shrubs at any time.

E.11 Weed Control

Caltrans utilizes Integrated Vegetation Management (IVM) methods for weed control for E family landscapes. There are seven general IVM methods including:

- Mechanical
- Manual
- Cultural
- Biological
- Chemical
- Thermal
- Structural

IVM is an environmentally sound system that uses all available knowledge, methods and tools to provide a long-term management strategy. This strategy minimizes losses caused by weeds and pests, with as little cost as possible and minimal disruption of the environment.

E.11.1 Mechanical

Mechanical method of weed control is mowing with a tractor-powered mower. (Hand-held power equipment such as weed-eaters and walk-behind mowers are a manual weed control method).

While there is limited use for a highway mower in a fully landscaped area, it is still a viable form of weed control. Highway mowers work best in plantings of occasional trees and shrubs (on bubbler irrigation) with large unplanted areas in-between.

Mowing may damage sensitive resources, native grasses, wildflowers and other plantings. Mowing height and timing are important. Refer to C2.11 of Maintenance Manual, Volume 1. Mowing can also spread noxious weeds. Consult with your District Landscape Specialist before you mow more than prescribed for your Maintenance area. Check your district's mowing plan in IMMS. Your District "Mowing Plan" may be viewed under "Assets" under VegCon Reports. Sensitive resources are also identified by the IMMS system at this same location.

E.11.2 Manual

Manual methods of weed control consist of weed control by hand. Manual methods include hand pulling, hoeing, or using hand-held power tools (such as a chainsaw, weedeaters and walk-behind mowers). The manual methods are usually the most expensive, but may be the only way to control existing weeds in planting areas. When considering manual control, using special programs people will help reduce the costs. Special programs people perform most of Caltrans manual control with Caltrans Maintenance personnel providing supervision and support.

E.11.3 Cultural

Cultural methods of Vegetation Management include a wide variety of general horticultural practices that promotes healthy plantings and discourage unwanted vegetation (weeds).

Selection of the right plant for the right place helps Caltrans achieve effective vegetation management in our landscapes. When selecting replacement plants, the plant species may be changed to another plant species if the original plant species had problems. Plant species changes must be approved. Contact your District Landscape Specialist before changing plant species.

Attention to irrigation timing, coverage and quantity encourages the growth of desirable plants and discourages the growth of weeds. Too much water stunts the growth of drought-tolerant plants and encourages undesirable water-loving weeds. Some of the hardiest plants we use, especially in Southern California, don't need regular watering in the arid months. You may need to consult with your District Landscape Specialist or District Landscape Architect to determine the appropriate irrigation schedule for plants in your area. Overhead spray heads irrigating unplanted ground wastes water and encourages weed growth.

Mulching applications at the recommended thickness will either suppress, reduce, or eliminate the growth of unwanted vegetation such as weeds. Mulch helps reduce Caltrans' dependence on herbicides. Mulching also serves as a moisture retention agent by insulating the soil from sun, heat, and winds, which accelerates the evaporation process.

Proper fertilizing practices will promote healthy root and foliage growth that will aid in the vegetation's ability to withstand adverse conditions. Poor fertilizing practices may lead to poor plant health and opportunity for weeds to establish.

Recommended pruning practices will enable a stronger root system, healthier foliage growth, and help withstand plant stress from extreme events such as high winds, soil contamination, or vehicle impacts.

Refer to Section E.10.

E.11.4 Biological

Biological control is the use of natural enemies to reduce a plant's pest population to the level at which it is no longer an economic problem. Most biological control organisms are predators, parasites and pathogens. Classical biological control involves the deliberate introduction and establishment of exotic natural enemies into areas where they did not previously occur. Biological control (as an IVM method) typically is slow acting, safe for human health and the environment, and low cost (very economical). In order for biological control to work effectively, some population of the pest must remain in order to provide habitat for the natural enemy. Biological control is not appropriate for immediate control, since it may take up to ten years to succeed.

E.11.5 Chemical

The chemical material should be chosen for effective use according to the needs of the job, the weather, the soil, and the characteristics of the herbicide.

Contact herbicides such as Reward, Pelargonic acid, and others, are effective in killing the tops of existing weeds. They often are desirable where chemical residue from other herbicides might contaminate soil or hurt the roots of nearby trees or shrubs. Contact herbicides may "knock-down" the tops of deep-rooted perennial weeds even though the roots are not permanently injured or killed. They are of special value for controlling annual weeds.

In general, except for Reward, contact weed killers are most effective when applied on warm, sunny days and are less effective in cold weather. Wet the plant thoroughly for a good kill. Runoff on the soil is ineffective, increases costs, and should be avoided

Pre-emergent herbicides will prevent seeding weed growth when applied on clean ground. They are dependent on being moved into the soil by either irrigation or rainfall. They may be selective of the plants they kill and may be chosen to kill weeds with no injury to intermingled ornamental shrubs by careful adjustment of rate of use. Some pre-emergent's, when used at safe rates in highway plantings, have a short residual effect after contact with the soil, whereas others allow a greater effective time between application and rainfall or germination of the seeds.

At certain rates, some pre-emergent's (such as Surflan) may be used in highway plantings. Other pre-emergent materials include Ronstar, Casoron, and various other formulations. These herbicides can be either selective or non-selective.

Translocating or systemic herbicides function by absorption into the leaf, stem, or root system and subsequent translocation to all parts of the plant. Some systemic herbicides are designed for spray application to the aerial plant parts, while others are designed to be applied to the soil as a pre-emergent. They may be selective or they may be non-selective, such as with glyphosate (Roundup), killing or damaging any plant material the herbicide touches.

Foliar application of systemic herbicides must be made during the active growing season when they will translocate throughout the plants. Root applications must be available to the plants when the plants are actively growing. Most systemic herbicides applied fairly are absorbed within 24 hours after application, although the kill may not become apparent for a week or more. These herbicides can be either selective or non-selective.

Growth retardants or inhibitors are intended to physically change plants by reducing the growth rate. Growth of shrubs, trees, groundcovers, etc., can be effectively controlled by use of these chemicals, thereby extending the periods between pruning, edging, or mowing.

Results depend on many factors such as plant material, location, weather conditions, and time of year. Label information of various products must be consulted prior to use. The materials should be tried experimentally before general use. The District Landscape Specialist will coordinate this for your operation.

Refer to C2.26 of Maintenance Manual, Volume 1 for a thorough discussion of herbicides.

E.11.6 Thermal

Thermal control is the use of fire or heat as a vegetation management tool. Thermal is not a preferred IVM method for established landscape plantings.

The use of prescribed burning for land management is a controversial topic. Permits and fire plans are required. How and when and whether to burn varies by vegetation type, target weed species, region, topography, management history, annual climatic variations, season, and weather (which itself can vary throughout the day). Thermal methods are best for rural areas with heavy weed infestations, and for re-establishment of native plants.

E.11.7 Structural

Structural control is the use of "hard materials" to reduce the amount of vegetative areas. Commonly known as hardscaping, structural control works best for areas closest to the roadway or in areas with high safety concerns. There are both permeable and non-permeable hardscaping materials. Hardscaping has many different patterns, colors, and textures to choose from. Hardscaping choices include fiber weed control mats, polyureas, rubber weed control mats, rock cobble, rock blanket (mortared cobble), rock slope protection, stamped asphalt, and patterned concrete.

Structural control is the best way to meet Caltrans' herbicide reduction goal of 80% by 2012. Request structural controls during design or rehabilitation projects, since this is the appropriate method for hardscape installation. Consult your District Landscape Architect. Areas to consider for structural control include medians, gore points, maintenance vehicle pullouts, slope paving, narrow areas, guardrails, signs, areas adjacent to bridge supports and other designs for safety items.

E.11.8 Toxicity of Landscape Chemicals

Chemical pesticides such as herbicides, insecticides, fungicides, and rodenticides are tools used in Caltrans Landscape maintenance operations.

Hundreds of products are registered and sold in California to control pests. The hazards involved in pesticides must be understood and respected by those who purchase and use them.

Federal and State laws regulating the many operations involving the purchase, storage, and use of pesticides change too frequently for inclusion in this manual.

The California Department of Pesticide Regulations (DPR) frequently publishes regulations to reflect changes. Copies of changes are available at DPR headquarters in Sacramento or from your Local County Agricultural Commissioner. It is imperative that each applicator, and others responsible for pesticide use, be aware of and complies with regulations as they become effective. A copy of a Pesticide Recommendation must be in possession of the chemical applicators.

Refer to C2.22 of Maintenance Manual, Volume 1 for a thorough discussion of pesticide toxicity.

E.12 Rodent Control

Effective rodent control depends on a thorough knowledge of rodents and rodenticides. Rodents' eating habits, burrowing patterns, and peculiarities require a wide knowledge of the rodents being controlled.

Chemicals used to control rodents are normally highly toxic materials. Even though they are used in a diluted form, they are difficult to use correctly and dangerous to handle.

Rodent control is best accomplished through a cooperative agreement or a service contract. Some County Agriculture Commissioners are willing and are staffed to do rodent control work through a cooperative agreement. Caltrans pays for the bait and labor.

Caltrans only use anti-coagulant rodenticides. Many County Agricultural Commissioner's sell anti-coagulant rodent bait at their offices.

Under no circumstances will the rodenticide Compound 1080 (Sodium Monofluoroacetate) be used on State highways.

Class 1 and restricted materials should be avoided. Contact your District Landscape Specialist for a Rodenticide Recommendation.

APPENDIX E-A

GLOSSARY OF PLANT AND PRUNING TERMS

ACCESSORY BUDS:	extra buds in the leaf axil.
ADVENTITIOUS BUD:	any bud arising anywhere except in the leaf axils.
ALTERNATE:	leaf or bud arrangement where there is only one leaf or bud at a node.
ANNUAL:	a plant completing a life cycle in a year and then dies.
ANTHER:	male or pollen bearing portion of stamen.
ASEXUAL:	reproduction by means of cuttings, leaves, roots, roots divisions.
ASSIMILATION:	transforming digested nutrients into protoplasm.
AXILLARY BUD:	bud in axil of a leaf.
BALLED:	plant transplanted with roots in a ball of earth.
BARE ROOT:	plant transplanted with no soil on the roots.
BERRY:	simple fleshy fruit, the ovary wall fleshy and including one or more carpels and seeds.
BIENNIAL:	plant that completes its life cycle within two years and then dies.
BOTANY:	science dealing with plant life.
BRANCH AXIL:	the angle formed where a branch joins another branch or stem of a woody plant.
BRANCH BARK RIDGE:	a ridge of bark that forms in the branch crotch that marks where the branch wood and trunk wood meet.
BRANCH COLLAR:	trunk tissue (a shoulder or bulge) that forms around the base of a branch or lateral between the main stem and the branch or a branch and a lateral.
BROADLEAF:	pinnate or palmate veins as contrasted to parallel venation of grasses.

BULB:	short, flattened, or disc-shaped underground stem, with many fleshy scale leaves filled with stored food.
CALLUS:	mass of large cells (tissue) that is formed by the cambium layer around a wound.
CALYX:	outside flower whorl.
CAMBIUM LAYER:	growth tissue just under the bark.
CAPSULE:	dry, dehiscent fruit with two or more carpel's.
CARPEL:	a floral leaf bearing ovules.
CHLOROPHYLL:	green coloring matter in cells.
COMPLETE FLOWER:	flower having the usual flower parts (petals, sepals, stamens, pistils, and carpels).
COMPOUND LEAF:	leaf made up of a number of separate parts.
CONIFER:	cone-bearing evergreen.
CORM:	short, solid, enlarged underground stem containing stored food.
COROLLA:	petals, usually the colored part of a flower.
CROWN:	the leaves and branches of a tree or shrub; the upper portion of a tree from the lowest branch on the trunk to the top.
CROWN CLEANING:	the removal of dead, dying, crowded, weakly attached, low-vigor branches and water sprouts from the tree's crown.
CROWN RAISING:	the removal of lower branches of a tree (skirting) to provide clearance for pedestrian, vehicles or to improve sight distance; at least one-half of the foliage should be on branches originating on the lower two-thirds of the trunk.
CROWN THINNING:	the selective removal of branches to increase light penetration and air movement, reduce wind resistance and weight; do not remove more than one-quarter of the living crown of a tree in a growing season.

CROWN REDUCTION:	reduction of the height or width of the crown by thinning to interior lateral branches; laterals should be at least one-third the diameter of the limb being removed; no more than one quarter of the leaf surface should be removed in a growing season.
COTYLEDON:	seed-leaf of a plant.
CUTICLE:	waxy layer on outer wall of epidermal cells.
CUTIN:	waxy substance very impermeable to water.
CUTTING:	a section of stem, root, or leaf, used for asexual reproduction of plants.
DECURRENT:	a major tree form resulting from weak apical control; trees with this form have several lateral branches that compete with the central stem for dominance resulting in a spherical round crown; most hardwood trees have a rounded crown; oak and ash trees are decurrent in form.
DECIDUOUS:	trees or shrubs that lose their leaves each fall.
DICOTYLEDON:	plant whose embryo has two leaves cotyledons bean.
DIOECIOUS:	male and female blooms on different individual plants (English Holly).
EGG:	female part of the flower contained in the ovary, which becomes the seed after fertilization and development.
ENZYME:	organic catalyst that is able to alter the rate of a chemical reaction.
EPIDERMIS:	outside layer of cells.
EVERGREEN:	a plant that retains old leaves until new ones have fully developed.
EXCURRENT:	a major tree form resulting from strong apical control; trees with this form have a strong central stem and pyramidal shape; lateral branches rarely compete for dominance; most conifers and a few hardwoods, such as liquidambar and tulip trees have excurrent forms.
FILAMENT:	stalk of stamen bearing the anther at the tip.

FLORABUNDA:	producing many flowers.
FLOWER:	that part of a plant containing the reproductive organs.
FOLIAGE:	the leafy portion of a plant.
FRUIT:	product of a plant containing the seeds.
GENE:	substance in a chromosome that determines hereditary characteristics.
GERMINATE:	to sprout or start growing from a seed.
GRAFT:	fasten a scion to a stock, usually the scion being another species.
GRASS:	plants with parallel venation.
GROUND COVER:	shrub, vine or dense growing plants used to control erosion or weeds.
GROWTH REGULATOR:	chemical used to increase or decrease the rate of plant growth.
HEADING:	a poor maintenance practice used to control the size of trees; involves the indiscriminate cutting to stubs, shoots, buds or branches not sufficiently large enough to assume the terminal role; synonyms terms include round-over, heading back, dehorning, topping and hat-racking.
HEDGE:	compact group of plants usually used as a screen or windbreak-- may or may not be formally trimmed.
HEEL IN:	cover roots with soil, shavings, etc., and water in.
HEREDITY:	transmission of characteristics or qualities from parent to offspring.
HORMONE:	a substance capable of influencing a specific physiological process even though present in minute quantities.
HUMIDITY:	amount of moisture in the air.
IMPERFECT FLOWER:	flower lacking either pistils or stamens.

INCOMPLETE FLOWER:	a flower lacking one or more of the four kinds of flower parts (calla lily).
INCLUDED BARK:	bark that is embedded between opposing branches and a main stem or two co-dominant stems creating a structurally weak point in the tree or shrub.
INFLORESCENCE:	a flower cluster.
INTERNODE:	region of stem between two successive nodes.
LATERAL:	a branch or twig growing from a parent branch or twig.
LATERAL BUD:	bud which grows out from the side of the stem.
LEAF:	thin flat part of a plant used chiefly to manufacture plant food.
LEAF AXIL:	angle formed by the leaf stalk and the stem.
LEAFLET:	separate part of the blade of a compound leaf.
LEGUME:	a two-valve seed pod, splitting along both edges when dry, as a pea or bean pod.
MONOCOTYLEDON:	plant whose embryo has one cotyledon.
MONOECIOUS:	stamens and pistils in separate flowers but borne on the same plant.
MUTATION:	deviation from parent characteristics not attributed to heredity.
NODE:	that portion of the stem where leaves and buds arise and where branches originate.
NUCLEUS:	a central mass around which matter grows.
NUTRIENT:	material that nourishes and promotes growth.
OPPOSITE:	bud or leaf arrangement in which there are two buds or two leaves at a node.
OSMOSIS:	passing of a dilute solution through a semi-permeable membrane into a more concentrated solution.
OVARY:	enlarged basal portion of the pistil that becomes the fruit.

PALMATELY VEINED:	leaf blade with several principal veins spreading out from the upper end of the petiole (maple, plane).
PARALLEL VEINED:	leaf blade in which veins are parallel to each other.
PARASITE:	organism deriving its food from the living body of another plant or animal.
PEDICEL:	individual stem of flower of an inflorescence.
PERENNIAL:	plants continuing to grow more than two years.
PERFECT FLOWER:	flower having both stamens and pistils.
PERIANTH:	petals and sepals taken together.
PETAL:	usually the conspicuous colored part of the flower.
PETIOLE:	stalk of leaf.
PHOTOSYNTHESIS:	carbon dioxide and water united chemically to form carbohydrates with the energy being furnished for the process by light.
PINNATELY VEINED:	leaf blade with a single midrib from which smaller veins branch off (elm).
PISTIL:	central organ of the flowers typically consisting of stigma, style and ovary.
PISTILLATE FLOWER:	flower having pistils but no stamens.
POLLINATION:	conveying pollen from the anther to the stigma.
RECEPTACLE:	enlarged end of the pedicel to which other flower parts are attached.
RENOVATE:	remove matted portion from the top layer of turf or lawn.
RHIZOME:	elongated underground, horizontal stem.
ROOT:	part of the plant that descends and fixes itself in the earth to anchor and nourish the rest of the plant.
RUNNER	stems growing horizontally along the ground surface.

SCION:	that part grafted onto the stock.
SEED:	part of a plant containing the embryo and stored food for a future plant.
SEPAL:	outside flower parts that usually enclose the other flower parts in the bud.
SESSILE:	leaf with no petiole.
SHEATH:	part of a leaf that wraps around the stem, as in grasses.
SHRUB:	a multiple stemmed woody plant smaller than a tree.
STAMEN:	male or pollen-bearing flower part consisting of an anther and filament.
STAMINATE FLOWER:	one having stamens but no pistils (begonia).
STIGMA:	sticky expanded end of the pistil to which pollen adheres.
STIPULE:	leaf-like structures growing from either side of the leaf base.
STOLON:	same as runner-horizontal stem growing above the surface of the ground.
STUNT:	suppressed growth.
STYLE:	threadlike tissue connecting the stigma and ovary and through which the pollen tube grows.
SYSTEMIC:	passing through the plant system.
TAXONOMY:	science dealing with naming, describing and classifying plants.
TENDRIL:	twining part of a plant that attaches itself to a supporting body.
TERMINAL BUD:	a bud at the end of a stem.
TISSUE:	cells of similar structure that perform a special function.
TOXIC:	poisonous.
TRANSLOCATE:	move from one part of a plant to another, usually from the leaves to the roots.

TRACING:	shaping a wound by removing loose bark from in and around a wound.
TREE:	woody plant having a single stem and branches.
TUBER:	short, fleshy, underground stem (potato).
TURF:	lawn grasses sod.
TURGOR:	pressure within the cell resulting from absorbed water.
VEGETATION:	plant growth.
VEINATION:	vein arrangement in leaf blade.
VINE:	a slender climbing plant.
WEED:	any plant growing uncultivated or noxious to cultivated crops; a plant growing in an unwanted location. The term “noxious weed” refers to a weed that is listed on the California Department of Food and Agriculture noxious list. The noxious weed list and rating system (A, B and C) is determined by the amount of monetary damage, or potential damage, to crops and livestock and the magnitude of weeds distribution.
WEED TREES:	unplanted trees, typically considered a very big weed.
WHORL:	a circle of leaves or flower parts.
WILT:	to droop or lose freshness.